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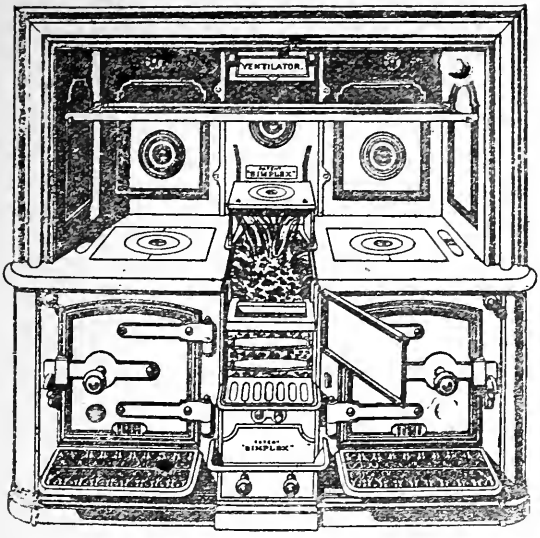

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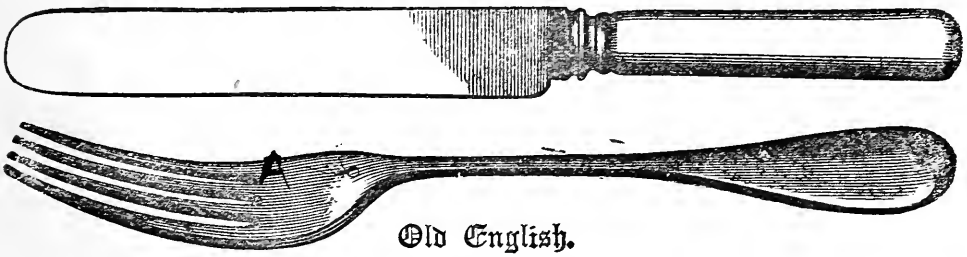

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POPULAR ERRORS IN REGARD TO MEDICINE.

By ROBERT W. FELKIN, M.D., F.R.S.E.

Mr Chairman, Ladies and Gentlemen,—I had no idea when I consented to give a lecture to the Health Society this year, that it would be my fate to have to give the first or introductory lecture. I wish that this duty had been in other hands than mine, for it is a great responsibility to strike the key-note of a course of lectures like this, and had I had the slightest idea that the task would fall to me, I should have chosen a very different theme from the one to which I have to call your attention this evening. However, I will try to do my best, and will hope that your estimate of this course of lectures will not depend upon my humble efforts.

The subject to which I am about to direct your thoughts is that of popular errors in regard to medicine, and I propose to treat it from two points of view. I shall first refer to the historical aspect of the subject, and shall then endeavour to deal with some of those very common errors with which we meet in the present day.

The idea of this lecture was suggested to me by Sir Thomas Browne's *Pseudodoxia Epidernica*, published in 1646. He says that the cause of error is complicated, that it is due to the common infirmity of human nature, and the erroneous disposition of the people, and that the more immediate causes of common error are misapprehension and fallacy and false deduction, credulity and supinity, and obstinate adherence unto antiquity; and probably the greatest cause is adherence unto authority. "What fool almost could believe, at least, what wise man would rely upon, that antidote delivered by Pierius in his hieroglyphics against the sting of a scorpion,—that is, to sit upon an ass with one's face

minated an anathema specially directed against surgery, by ordaining that as the church abhorred all cruel or sanguinary practices, no priest should be permitted to follow surgery or to perform any operations in which either instruments of steel or fire were employed; and that they should refuse their benediction to all those who professed and pursued it."

"In many catholic countries the saints have proved sad enemies to the doctors. Miraculous cures are attested by monks, abbots, bishops, popes, and consecrated saints. St Martin's shrine alone is said to have restored fifty blind people to the blessing of sight; stories related no less at variance with the sentiments and characters of the men than contradicted by the laws of nature." Different saints were prayed to to protect from particular diseases—St Anthony, for instance, against inflammations; St Apollonia, against toothache; St Christopher and St Mark, against sudden death; St Clara, against sore eyes; St Germanus, against the diseases of children; and St John against epilepsy and poison.

"The kingdom of Ireland affords numerous examples of superstitions entertained with regard to the miraculous power of certain fountains, holy wells, &c. . . . . and the visiting of certain wells, supposed to have healing properties, in the month of May, is recorded as one of the superstitions of the Scotch."

With regard to amulets or charms, they were, and still are, much used in the East. Among the Mohamedans the amulet generally consists of certain names of the Deity or verses of the Koran rolled up into a very small space and concealed in the folds of the turban. The Christians wore amulets with verses selected from the Old or New Testament, and particularly from the Gospel of St John. These charms were sold as preservatives against thunderbolts and diseases, to avert shipwreck or slavery and to secure victory in battle. The necklaces so commonly found on the Egyptian mummies were no doubt used as amulets to preserve the integrity of the body.

The African of to-day will gather his herb or root when the silver crescent of the moon first becomes visible in the azure sky, and after various incantations he will sew it up in a small piece of leather and hang it round his neck, in the firm belief that he can now bid defiance to smallpox; or when the peals of thunder shake the earth, and the lightning flashes illuminate the dark glade of

some virgin forest, he will bid defiance to the elements and seek some glistening crystal as a charm to ensure a numerous progeny.

The Orientals generally have a belief in the influence of what is called "the evil eye," to the operation of which children are supposed to be most susceptible. To avert the consequences, they are furnished with charms of various kinds. Coral bound to the neck was said to take away bad dreams and allay the nightly fears of children.

I might spend the whole of my time this evening in relating to you curious ideas that have been believed in various ages. I will content myself with mentioning only two or three more, and must then pass on to another part of my subject.

In Berkshire, a ring made from a piece of silver collected at the communion was regarded as a cure for convulsions and fits. A halter, with which anyone has been hanged, if tied round the head, was believed to be a cure for the headache. Fried mice used to be considered a specific for smallpox, always provided that they were fried alive. To cure a quartan ague, the fourth book of Homer's "Iliad" below the head was prescribed by the physician and poet Sammonicus. It is a common superstition in Devonshire, Cornwall, and some other parts of England, that for the whooping cough you have only to inquire for a remedy from anyone riding on a piebald horse, and if his suggestion is applied cure is certain.

There can be no doubt that until recently the empirical and unscientific use of drugs, even by qualified physicians, tended to keep alive many of the errors and superstitions with which the common folk regarded both disease and its treatment, but surely in the nineteenth century one would expect education to have done more than it has to dissipate these strange beliefs. Yet hear what occurs in Paris now, despite its claim to be the centre of modern civilisation. A woman, whose child was suffering from inflammation of the brain, consented to try an old wives' remedy, and accordingly allowed a pigeon to be killed on the little patient's head, in the belief that the malady would be absorbed by the pigeon's flowing blood. The doctor in attendance learned to his surprise that the practice is by no means uncommon, and that one woman in the Halles sells on a daily average ten or twelve pigeons destined for this singular sacrifice. I suppose that

in Scotland there are as many of such strange superstitions as can be found in any other civilised country, perhaps more. I cannot attempt to go into them now, but may just mention a prescription that was given by a certificated midwife, who is the only practitioner in an island on the west coast of Scotland, containing some hundreds of inhabitants.—If the baby is ill and not thriving, take a cat by the four feet, swing it round and round the infant several times, then throw it out of the hole in the roof for letting out the smoke. If it is a black cat, or if the house has a chimney, then throw the cat out of the window; if the cat dies, the child will live, because the witches or brownies have left the child and gone into the cat. If the cat does not die, then the child will.

I must now say a few words about quack doctors and patent medicines. Walking through the Grassmarket a few weeks ago, my attention was drawn to a motley crowd—poor men, men well-to-do, boys, girls, women with infants in their arms, were standing with some evidently interesting object in view. In the midst of the crowd I found that a man was standing on a chair waving some bright red handbills. I stopped to hear what he had to say, and discovered that according to his own account he possessed the panacea for all the ills that flesh is heir to. It was a yellow salve, warranted to cure cuts, burns, broken limbs, to give sight to the blind, hearing to the deaf. His voice was rough, his speech rude, his clothes were—well, not exactly clean. I passed on, but returning the same way some two hours later, I saw him still there, and still doing a roaring trade. While I stood looking on, he sold his ointment to a blind man, to a young woman suffering from some skin disease, and to a well-dressed clerk who said he was suffering from a bad cough. Is it credible that in these days of board schools and higher education people can yet be found who trust, and pay for, trash like this? Alas, it is only too true.

It is a popular notion that advertised medicines cure far better that any so-called doctor's stuff. Look at the fortunes amassed by quacks. See the advertisements in the daily and weekly papers—think of the money spent on them, and you will then realise how the people are deluded, robbed, and swindled. I will not name any of the patent medicines to which I refer. It would be only a gratis advertisement. People think that the Govern-

ment stamp on patent medicines is a guarantee of their genuineness and efficacy. Was ever error greater, was ever stupidity more gross? The stamp is a tax, and the public pay, not only a hundred times too much for the stuff they get, but also a tax for the privilege of taking either totally inert substances or else such as often do great harm, and even at times kill the credulous swallowers. It must be remembered with regard to quacks, that they do not publish their failures. Every lucky cure is blazoned forth, and of course not a few of the cures are greatly exaggerated, while many of the professed cures have no existence except in the fertile imagination of the would-be doctor.

I may quote a few words here written by Dr Pettigrew. He says—"Medicine has been and still continues to be an art so conjectural and uncertain that our astonishment at the anxiety with which empirics have been sought after and followed is much diminished. Regular professional men are too sensible of the deficiencies, and too keenly alive to the uncertainty, of the power of medicines over disease, to venture to speak boldly and decisively, so as to gain the entire confidence of their patients, whose natural irritability is perhaps, under the influence of disease, much excited, increased and aggravated. The bold and unblushing assertion of the empiric of a never-failing remedy, constantly reiterated, inspires confidence in the invalid, and not unfrequently tends by its operation on the mind to assist in the eradication of disorder. Few people possess either leisure or inclination in large and populous places, where alone the quack sets upon his work of deception, and not unfrequently destruction, to examine into and detect the imposition. Human credulity is too strong to resist the bold and unblushing assertions of the empiric, and to his hand is readily committed the care of the most precious gift of heaven."

Southey was quite right when he said, "Man is a dupeable animal. Quacks in medicine, quacks in religion, and quacks in politics know this, and act upon that knowledge. There is scarcely any one who may not, like a trout, be taken by tickling."

I must call your attention to another popular error with regard to medicine. I often meet with people who seem to think that one "bottle" or one prescription is useful for all complaints. It

would be a blessing indeed if we could take a leaf out of the Continental book, and forbid all chemists to make up a prescription twice without the initials of the doctor who gave the prescription being re-appended, unless he had indicated that it should be dispensed again and again. A person is ill, a doctor is called in and prescribes for him, and, we will suppose, cures him. Shortly afterwards a neighbour takes ill. To the friends he seems to suffer from the same symptoms, whereupon the old prescription is unearthed, or another one, for, not being able to decipher the doctor's hieroglyphics, so long as a paper with an eligible formula is found, it is all that is needed. This is sent to the chemist, the medicine is procured, and the patient runs a good chance of becoming worse or of being killed. This is no fanciful idea on my part. I could refer you to no less than three deaths which I am convinced have been brought about by this unreasoning advice on the part of the friends of a sick person.

It is a grievous error to suppose that the drugs ordered by the skilled physician for the relief of sickness and pain may be taken freely with impunity. Such is not the case, and the reckless self-administration of such drugs as chloroform, chlorodyne, chloral, ether, and opium causes many deaths and much suffering in the present day. Men and women alike fly for supposed relief to these potent weapons for good or ill, but it should be borne in mind that when taken indiscriminately these drugs, instead of proving a boon and blessing to men, become a veritable curse.

Another very prevalent error is the method adopted by people in giving medicines. No medicine should be administered before the directions on the bottle are read, and yet how often do we find this precaution neglected. It would be best, no doubt, if proper medicine glasses were used to measure the dose, but apart from that, dirty spoons, irregular hours, hap-hazard doses, are far too frequent, and it is a wonder to me that more accidents do not result from this careless, thoughtless custom.

An old saw has it, "A little knowledge is a dangerous thing," but with regard to medicine this maxim does not seem to apply, if we are to judge from the amount of self-doctoring that prevails. We have popular lectures on medicine, we have books and even weekly papers published, professing to teach the laity what to do

in cases of sickness. Now it is not my wish to object to, or to depreciate the advantage to be derived from, a certain amount of knowledge of minor ailments, nor would I say anything against the education of the people on first aids to the sick or wounded, in cases of accident or sudden illness. I must, however, object, and that very strongly, to the error of thinking that every man may be his own doctor, as—so we are told—he may be his own lawyer, his own architect, his own builder. An old Italian proverb reads thus, "I was ill—I wished to be better—read medical books—took medicine—and died." I should like to add—and it served you right. Do the people realise what it involves to be a medical man? do they take into account the time, the money, the hard study which is required before he can add the magic letters, "M.D.," to his name? Do they appreciate the risks he has run, the midnight oil he has burned, before he is competent to treat the very least of their ailments? And yet they seem to think that a glance at some of these popular educators with reference to medicine will qualify them to be doctors unto themselves. Suppose, for a moment, that you were to read a book on engineering, would you be qualified for, or capable of, building a bridge? No, you are not so stupid as to think that, but you do think that, by the mere perusal of a shilling, sixpenny, or even penny guide to health, you may become proficient in the treatment of yourself or of those near and dear to you. The other day a man came and asked me to be good enough to give him a certificate to the effect that he was suffering from cancer. The Sick Society in which he had insured would not take his own word for it, and therefore, much against his will, he was compelled to waste the money necessary to obtain a physician's opinion. I examined him, but of cancer could find no trace, and I told him that he could soon be cured, as he was only suffering from dyspepsia. Thereupon he brought out a well-worn pamphlet, saying that I must be very badly up in my profession, for he complained of all the symptoms which this brochure said were those of cancer. He is well now, a wiser, but, I fear, not a more grateful man.

An error just as great as that to which I have just referred is the habit of calling in a doctor "too late." It is useless to lock the stable door when the horse is gone. No one has an excuse

for such shortsightedness in this city. If people can pay for advice they can always obtain it, and if unable to afford a fee at all they can get advice at one of the numerous dispensaries, or a doctor to visit them at their own houses from the same establishment. Speaking of dispensaries, I may perhaps be permitted to remark that they are much abused by persons who only want to see a doctor in order to get a line from him for the purpose of obtaining relief from some Sick Society. It is impossible for a doctor to investigate all these cases himself, so as to find out whether the people are really in need of help or not, and I think that, on this account, less importance should be attached to doctors' lines by the charitable societies.

One or two errors may be mentioned with regard to vaccination. There is certainly not so much objection made in Scotland to having children vaccinated as there is in England, but I think I am right in saying that the number of people who object to this prevention of a dire disease is on the increase. This is a great pity, for the benefits which vaccination confers are so great that no one has the right to try to evade it, and so to expose his children, not only to the risk of death, but, if spared, to grave subsequent risks, such as blindness, deafness, permanent debility, to say nothing of a disfigured face. It is an error to suppose that all skin diseases from which a child suffers after it has been vaccinated are due to the vaccination. It is not so, but it is very convenient for some people to put the blame on vaccination for diseases which have in reality an hereditary origin.

Again, it is an error to suppose that an adult cannot become revaccinated from a child. Great care should be taken not to get the vaccine from a child's arm into a scratch or cut. Curiously enough, I have seen six cases of this accident during the past few months. In one case a father was vaccinated on his chin, in another a mother on her cheek, and a sister was thus affected just at the outer corner of her eye, and very soon she lost the sight of the eye. These accidents would not occur were proper care taken. It may be well for me to mention a few precautions which should be followed. The child's arm should not be rubbed, nothing should be tight above the place operated on, the arm should be out of the sleeve. The vesicles should be left to dry into scabs, and the scabs permitted to fall off. The arm

should not be poulticed, and as, on the eighth to the tenth day after vaccination, the child's arm becomes naturally inflamed, it should either be dressed with flour, or finely powdered starch should be dusted over it, and the child should have a teaspoonful of castor oil. Many mothers greatly object to permitting lymph to be taken from the child's arm, imagining that it also takes away from its strength. This is quite a mistake. If the lymph be properly taken, it does the child no harm whatever, and can transmit no disease, but is, in fact, a positive benefit. It is also a selfish thing to refuse to permit another to benefit by the lymph which has protected one's own child.

Dr Primrose, in 1657, called attention to the popular error that the linen of the sick should not be changed, and I find that this idea still prevails. Mothers will tell one that to change the linen often enfeebles the patient. Can anything be more absurd? Every sick person should have the bed made once in the day, in the morning by preference, as he can best bear it then. The sheets and nightdress should be changed as occasion requires, and the patient should be sponged all over once a day. If care is taken, no possible harm can come of this. Sponge one part at a time under a blanket, and you will find the patient much refreshed and benefited. To leave a patient lying in an unmade bed in dirty sheets and dress is most cruel. The perspiration from the body soaks the bed-clothes, they are apt to be soiled by discharges, and the patient lies in an unhealthy atmosphere. Bed sores, too, are apt to occur in persons who are very weak and confined to bed for a long time. The ancients should put to shame us of the nineteenth century; they used to bath and rub their patients often, and Hippocrates bade "that all be kept clean about the bed."

Many think that if they have removed a smell they have disinfected an apartment. This notion, though prevalent, is false. Burning brown paper or pastilles and the sprinkling about of scents do not disinfect. To do this, proper chemicals are required, and they must be used in a proper manner. People forget that disinfection, in the proper sense of the term, means any process by which the contagion of a given disease may be destroyed or be rendered inert. I have not time to go into this subject now, but

would venture to recommend all who have to disinfect to obtain the necessary instruction.

It has often been a matter of surprise to me that there should be so many errors in regard to poulticing. It is rare to see a poultice properly made, and people have most curious ideas as to the use of poultices. Again and again have I ordered patients to have poultices applied, and found on my return that my orders had been neglected. Perhaps a well-meaning but ignorant district visitor has called, and wondered at a doctor ordering the child to be poulticed, or else the mother or grandmother, or some other ancient relation, has given the opinion that poultices were either useless or injurious. It is no good to apply one poultice and then to expect that the invalid will be cured. Cold poultices instead of hot, small poultices instead of large, heavy poultices instead of light—all these varieties we meet with. Let me remind you that poultices are ordered for the following reasons. Either to subdue inflammation by the application of external moisture and warmth, or to relieve pain, or to stimulate the skin, or to act as a disinfectant. Now, for poultices to act in any of these ways, with the exception of stimulating the skin, they must be renewed continuously; unless this is done, it would be far better not to apply them at all, for they then do more harm than good.

Another popular error which I must mention, is the mistaken idea that "milk" is not "meat." No end of harm is done, more especially to infants, by ignorance upon this point. Up to the age of seven months an infant should receive nothing but milk, and, by preference, its mother's milk, and yet we find that amongst the poor all manner of additions are made to the diet provided by nature. Often I have had to protest against the superstition that whisky is the first thing an infant should partake of, and pieces, bits of meat, &c., &c., are forced upon the unfortunate infants by the ignorant mothers. Little do they realise the harm they do; and, as a matter of fact, the great mortality of infants under a year old is caused by improper articles of diet. The practice of giving gruel, cornflour, &c., is very reprehensible, and you may take it for granted that the children would thrive far better were they fed at regular intervals upon milk. I say regular intervals advisedly. A child should not be fed whenever it cries; its stomach must have

rest just as much as the stomach of a grown-up person. For the first six weeks of its life it should only be fed every two hours; subsequently every three, and during the night it need not be fed so often. If mothers only remembered this and carried it out in practice, they would soon find that their children would learn regular habits, and that it would be better for both parties concerned. After a child has a few teeth it may be given a little well-baked bread or well-boiled porridge, but it should still have plenty of milk, and until the child is two years old no solid animal food should be given it. How much harm too is done by giving children tea, beer, whisky and other stimulants; cheese, fruit, pastry, &c. None but the very simplest medicines should ever be administered to a child except on the prescription of a doctor.

It is a grave mistake for mothers to give their infants sleeping draughts, soothing syrups, and teething powders. In a tract published by Mr J. Morley in 1847, he uses words which I may quote as applicable to the present day, "You have, no doubt, seen a Bible print which figures Herod's murdering of the innocents. Mothers cling in agony around children whose breasts are pierced, and infants struggle in the grasp of brawny soldiers. That was a fearful slaughter; yet it was mercy when compared with the more fearful murdering, the yet more devastating slaughter, among which we daily move. In Herod's time there was one day of slaying; in our own time there is not one day of rest. Then death came by the sword with one short pain, and mothers struggled to preserve their offspring; now children perish with the lingering torments of a poison, and drops of death are dealt out to them by a mother's hand." The sale (of these poisons) extends to every corner of our land. This state of matters will still continue so long as drugs are dispensed in the reckless manner which obtains at present, and until counter-prescribing is stopped and the evils of infantile life assurance are swept from our statute book.

The next subject to which I call your attention is a delicate one, and one which I trust you will not misunderstand. It is a popular delusion that all drunkards are wicked, and this error causes a great deal of misery and woe in this world of ours. Far be it from me to in any way diminish the reprobation with which drunkenness is viewed nowadays, but at the same time I am con-

vinced that if people understood that in many of the sad cases we see on all hands the poor victim is suffering from a real disease, and one which may often be cured, a great deal might be done to restore happiness to many a home. It is very sad to see again and again in our daily papers that so-and-so has been either fined or imprisoned for the 50th, 60th, or even the 100th time, for being drunk and disorderly. Now many of these poor creatures are as much to be pitied as a man with epilepsy or a woman in consumption. This fact should be known and appreciated, for it would then be within our power to indicate a possible way of cure. These unfortunate individuals are suffering from dypsomania, or a craving for drink, and in many cases, were they removed from their homes and surroundings for a period varying from six months to two years, they could be cured of their craving for alcohol and turned into good and useful members of the community. Far more attention has been given to this subject in America and the Colonies than here, and with great and surprising results. I have not time to give you statistics, but the vast majority of persons who have been treated have recovered. Apart from the advantage to the individual, the State would gain by the proper treatment of this class of cases. It is computed that the monetary value to the State of the thirty-six patients who have been discharged cured from the Dalrymple Home in England in the three and a-half years since it was opened, is £36,000 a year, and in addition to this the State has been saved the expense which would have been incurred through the breaches of the law by some of these persons when under the influence of drink. The sum of £123,000,000 was spent in 1886 in the United Kingdom on drink, a great part of this being expended by the persons to whom I have referred. It would be a good thing were it more generally known than it is, that drinking habits are sometimes a disease and sometimes a crime, and that they call for either punishment and repression or for medical treatment and moral control. Surely it is time that this subject should receive the earnest attention of our rulers, our clergy, and the public at large, and that measures be taken to try and reclaim those who are indeed bound by the chains of misery and iron.

On the other hand, it is a popular error that alcohol is necessary for the average healthy man or woman. It is not needful,

and in many cases it is hurtful. A glance at the death-rate of the Insurance Companies will perhaps afford the best proof of this fact. In the years 1866-86, the United Kingdom Temperance and General Provident Association expected in the general section 57,840 deaths. The actual deaths which took place were 57,677, leaving the very small margin of 163. In the temperance section 3655 deaths were expected, and only 2279 occurred, or 1376 less than expected. No words of mine are needed as a commentary on these pregnant figures.

A subject akin to the one just dealt with is the popular error that it is a moral slur to have been in an asylum. People still seem to have an innate, if unexpressed idea, that insanity is a demoniacal possession. Away with such medieval ideas and superstitions! Insanity is a disease pure and simple, a disease as much as scarlet fever, or inflammation of the lungs. Scarlet fever may kill, and an insane patient may die or never recover, but the one should be treated with the same wisdom and tenderness as the other, and on recovery there should be no foolish allusions to the past, as if there could be the slightest shame in having suffered from disease of the brain. Probably one of the greatest advances which have been made during the past fifty years is the improved treatment of the insane, and we in Edinburgh can point with pride to the noble work done in this direction at Morningside. Life nowadays is a whirl, a rush, a struggle, and can it be wondered at that many a one breaks down temporarily? The best and kindest thing is for such a person to be treated at once, for the sooner treatment begins, the greater likelihood there is of cure.

And now, with your permission, I should like to refer to the popular errors with regard to hospitals or infirmaries. The errors are of two kinds. The first is that some people who are well-to-do, think that these institutions are established for their benefit. Nothing of the kind. They are intended for the needy and distressed, for those who cannot afford to pay for treatment, and for accidents which, owing to their gravity, cannot well be treated at the patient's home. Look at the out-patient department of any hospital, and what do you see? People who can well afford to pay for a doctor go there for advice, and often treatment, frequently putting on old clothes for the occasion. These people have,

it appears to me, no sense of right or wrong. They are selfish, for they take up the time which should be given to their neighbours; they are dishonest and deceitful, for their mere presence implies inability to afford medical attendance at home, whereas they are in good circumstances. The abuse of the out-patient department pauperises the people, and it would be well if some method were invented to check this wanton abuse. I should like to see a list of the names and addresses of the patients who apply for advice at our Infirmary published for a few months; the revelation it would make would be a surprise to most of us.

The other error is in regard to admission into infirmaries, and here I refer to a different class of people, namely, the poor. The other day I was called to see a child suffering from croup. It was very ill; I thought it not impossible that an operation would be required for its relief, and as the room in which the people lived was totally unfitted for the successful treatment of the child, I asked the mother to take it to the Infirmary. This, however, she refused to do, saying that they had already killed two of her children there by giving them a bath! The prejudice on this subject is astounding; the fear the people have of water is almost too great to express. After several years' work in connection with various dispensaries in this city, I can say, without fear of contradiction, that, amongst the poorer classes, cleanliness and fresh air are abhorred by those in charge of the sick, and because these two very necessary items are insisted upon at hospitals, the poor fear to send their children to them. Would a doctor order a bath if he thought it would kill a child? The question is so absurd that one almost blushes to propound it. Yet the bath on admission to the hospital wards is, I believe, the greatest preventive of the poor utilising the best means in many cases of saving their children from a premature grave. The idea too that children will be unhappy in an Infirmary is quite an erroneous one. Children know when they are well off, and soon after the parents and friends have left you will see the little mites as happy as possible. The doctors and nurses do all they can to make them happy, and in many cases, sad though the fact is, the happiest days of many a child's life are spent within the walls of a Sick Children's Hospital.

The next subject I have to mention is a very solemn and a

very sad one, and one upon which I would dwell with all due reverence. I refer to the popular errors with regard to faith-healing, Christian science, mind cure or mental medicine, for by these various names it is known. It is practised largely in America, and I should have ignored it altogether, were it not that its evil effects are beginning to be felt in this country. During the last few years a good number of cases have come under my notice. I considered it my duty to try and make myself acquainted with it as far as possible. I visited a home of faith in London, I attended the faith-healing meetings held not long ago in this city. I have read a considerable amount of literature on the subject, and talked with some of those who are professors of the cult, as well as with patients who profess to have been cured, and with those who have been treated and not benefited. I would strongly and advisedly urge you to have nothing to do with the subject. In America there are actually so-called Metaphysical Colleges where license to practise this so-called divine science is given. A book has been published by the lady president of one of these colleges which has printed on the title-page — "The standard work on Mind Healing, including the theory and practice of Christian Science. The sick are healed from simply reading this book." This quotation speaks for itself.

It would serve no good purpose were I to attempt to follow these people into the strange and deluded opinions they set forth. The subject is too serious to be hurriedly summarised. I can, however, state my belief that they are misguided enthusiasts, who do great harm by their assumption of powers not given now to man. It is not difficult for us to account for their cures in a natural way, but before showing you how this may be done, I will cite two instances of deaths resulting from their pernicious belief.

A woman, who was a believer in the faith-healing doctrine, fractured her arm, but she relied on faith to effect a cure, declaring that she had been cured of erysipelas and other ailments by faith. The fractured limb, however, instead of healing, grew worse, and other alarming symptoms setting in, a doctor was sought. He recommended, as the only means of saving life, that an operation should be performed. The husband declined to have an operation, and the poor woman died.

A few weeks ago a woman was suffering from strangulated rupture, and refused to use the ordinary means of cure. The consequence was that she died in three days, in spite of anointing, and prayers for the restoration of her health.

There are many such cases on record, which show the harm of rejecting the means which God has given us, and expecting Him instead to perform miracles on our behalf.

You may naturally ask me how it is that cures, and real cures, too, do follow the methods used by these people. This question can be answered thus. Some cases of illness naturally tend towards recovery; there are other cases in which prolonged rest will cure a patient; in some nervous diseases all that is required is rest for months or years. At the end of this time some mental impression is produced upon the person, who is immediately cured. Others, again, are cases of persons suffering from hysterical affections, and as we know only too well that the mind influences the body and the body the mind, so, often, a great mental effort will cure persons who otherwise would be invalids for life. A strong galvanic battery would in many such cases be just as efficacious as these mental impressions. It will be found upon investigation that the cures wrought by the faith-healers owe their efficacy to the fact of the mental impression produced.

The following are good examples of cases which may be cured through faith-healing. Dr Richardson, in his "Diseases of Modern Life" says, "I was on one occasion consulted about a young woman, who, having been for some weeks in close communion with a patient suffering from pulmonary consumption, commenced gradually to imitate the movements of breathing and the cough of the consumptive sufferer. Gradually other symptoms were acquired, including the most perfect representation of the voice of the real patient. The paroxysm of cough increased, and the symptoms altogether seemed so real, there was, on the part of the friends of the unconsciously imitative girl, no doubt of her ultimate fate. The stethoscope and the other subjective means for detection of disease yielded, however, no evidence of the actual existence of the graver malady, and after two years of symptoms, during which time the patient went the usual round of dispensary and hospital for advice, she suddenly recovered, as I and many of my learned brethren had foretold."

He also cites the following case: "A lady I attended heard the details of an attack of paralysis in one of her friends, whereupon she began to present the same symptoms herself. She lost, day by day, the power of her lower limbs, and, later still, the voluntary command over the whole of the lower half of her body. For many weeks this condition was present—the patient remaining so helpless that she could not, even in bed, raise her lower limbs, much less move on them. At last, during a great crisis in her family circle, when one of the circle was expected to die, a sudden scream from an adjoining room roused her apparently dead members into life. She rose from her bed unassisted, walked rapidly into the room where the other patient was lying, and, from that moment recovered the entire use of the previously, and, as they seemed, hopelessly, palsied limbs. The new mental condition that was aroused constituted the cure.

Believe me when I say that I do not hold the faith-healers up to ridicule. Far from it; but I do mean most emphatically to state that I have no possible sympathy at all with those who profess to cure real physical ailments by mental impressions. It is impossible.

I should like to touch upon an error which is rapidly gaining ground in these days, and which, in my opinion, is a very serious one. I refer to the idea that, after all, women are not made on a different mould from men, but are possessed of the same brain power and capable of the same mental and physical attainments. Now, in approaching this question, one point of view is usually lost sight of. Some thirty years ago it used to be considered a degrading thing for a lady to work for her own support, so that, if she were not married, there was hardly any other sphere of life open to her. *Now* it is thought a right and dignified thing for ladies to take positions and enter spheres of labour which were once denied them, and, in many directions, intellectual pursuits are being followed by them, and openings of various kinds are being worthily filled; all of which is far better than that they should lead aimless, idle lives. But this very improvement is in itself a source of great danger; and I feel it to be of the utmost importance that this danger should be realised. Women are beginning to think that they may do anything, and it is not an uncommon remark, "men do it; why should not I?" Now,

from a medical point of view, there could not be a greater error than this. Men and women are constituted differently, and are not intended to fulfil the same rôle in life. This would indeed be a strange world if we were alike. We cannot afford to lose those qualities in women which make them different from ourselves. We men cannot attempt to do their work; we are incapable of it; and the sooner they learn that they are incapable of doing a great many things that men do the better for us all. There are physiological reasons why women cannot become soldiers and sailors, or why they cannot bear the physical hardships which men are called to undergo. It is not well, I am convinced, to instil into the minds of the rising generation that all the barriers are to be broken down between the sexes, and, whilst I would right willingly concede to women all possible means of gaining a livelihood, I think they will do well to realise and acknowledge their true position and their true rights. I take it that woman's rights are—that she should be respected, protected, honoured, loved; not that she should enter into the sharp contest of men's life.

In the battle of life we have each our appointed work, each our definite sphere, and *never* may the time come when the true womanly shall have put off her womanliness and have descended from the pedestal of admiration and respect which she now occupies throughout the whole civilised world.

Again, think of the errors which are being perpetrated day by day in the education of our girls, in the strenuous efforts put forth to fit them to compete with boys. It is simply appalling to ignore all physiological rules in the training of girls, to scorn the indisputable functions which sharply define the one sex from the other. Indescribable harm is being done by the false doctrine which urges forward the girl to excel the boy of her own age in passing the same examinations. Those who boast that Miss Pale-face has beaten the "men" by so many marks at such and such an examination, should rather blush that they have done their best to ruin a bright young being, and to sow the seeds of disease in one, who, with proper physiological training and a rather longer and modified course of instruction, would have been an ornament to her sex. We have societies for the prevention of cruelty to animals; I think it is high time to advocate a society

for the prevention of cruelty to girls, and to insist on a system of training and education based upon true physiological lines. I say this in all seriousness; it is sad to see the wan faces, the broken spirits, the listless movements of these devotees to the higher education of women.

And now I come to another popular error. It is this, that doctors should do other people's charity for them—gratis, of course. How often do we get letters saying—"Dear Dr, Mrs So-and-so is *so* ill; would you be so good as to go and see her on my behalf? She is a most deserving woman, has tried to bring up her children in the most exemplary manner, she attends my mothers' meetings, and I am *very* interested in her.—Yours very sincerely, —— ——. P.S.—I may say that Mrs So-and-so cannot pay a fee, but you will get your reward." And so I or one of my professional brethren is saddled with a "chronic," a very chronic case, and the probability is that this patient will give as much trouble as possible, will tell all her neighbours how good and kind the lady is, but will almost to a dead certainty ignore the time, trouble, and often the expense to which the poor doctor, the real dispenser of the charity, has been put. A friend of mine had last year more than a hundred such visits to pay for a lady who was his patient, while she herself only required his attendance five times. As this sort of thing had gone on for several years, his patience was at last exhausted, and he sent the lady a bill for one year's visits to her *protegées*. She was incensed, and sent him word that for the future she dispensed with his services. For this, I think, he may well congratulate himself. No one of us will refuse to attend a case of real distress, but it is rather too bad for us to be expected to give our attention to all and sundry of the *protegées* of our rich patients, who, when their own bill is sent in, will criticise it, and say, minus thanks, "O, Doctor, you are so dear."

I will now touch upon another medical error in fear and trembling. It is an error with regard to medical fees, and yet I do not know why I should fear to touch upon it, for I suppose that doctors have just as much right to live as other people. If our butcher and our baker were not paid for the articles they supplied or for the work they did, they would consider us defaulters, and we should probably hear more on the subject. But with regard

to the doctor, people seem to have different ideas. The daily fees, it is true, are not handed with regret, for the patient is still suffering, but if they are allowed to accumulate to a considerable amount, they are not parted with without many a lingering look, and it is surprising how often the bills are not paid at all. Dr Pettigrew says: "The difficulty in obtaining remuneration has unfortunately rendered many physicians somewhat sordid and loath to give an opinion unless paid for. In this they were unquestionably right, as gratuitous advice is seldom heeded; and one of the most distinguished practitioners used to say that he considered the fee so necessary to give weight to an opinion that when he looked at his own tongue in the glass he slipped a guinea from one pocket to another."

It is a popular delusion that a doctor's advice is worth nothing unless accompanied by medicine, which accounts for the story I heard lately of a doctor who had attended a family for some little time and then requested his fee. This request seems to have caused great astonishment, and it met with no other response than the exclamation—"D'ye think we're gane tae pye ye for the win' o' yere mou'."

Just as I write this, I have been interrupted by a respectably dressed woman, who requested me to prescribe for her child. I gave her the prescription, and she then asked me what she was to do with it. "Why, take it to the chemist's," said I. "The doctor's shop?" said she. "Yes." "Well then," she said, "I cannot afford to pay you and the chemist!"

The people do not realise the capital we have expended, nor the time and labour which it has cost us in qualifying to obtain the right to hold their lives in our hands. Nor do they realise the anxiety and responsibility which we undergo in treating them.

With reference to all this, I must beg you to observe that the practice of medicine is not of itself either a money-making and honour-getting, or an easy, idle way of gaining a livelihood. Immense fortunes, national honours, social distinctions, and popular applause belong not to us. The divine, the statesman, the lawyer, the commercial man can calculate with some amount of certainty upon these things. We, however, must rest content with the unostentatious rewards of conscience, with the gratitude of our

patients—when we get it—and with the knowledge that we have done our best to relieve to some extent the sum of misery in the world. And we will gladly be content with this. On the whole, we have a busier time than most. We can never call an hour our own; we run far greater risks than those which are run in any of the other walks of life; we die far earlier than any other class of men; therefore, it is a grave popular error to depreciate the hard-worked medical practitioner.

In the early part of my lecture I gave you some idea of the superstitions and errors of the ancients. Many of them, you will admit, are very laughable and absurd, but then we must, to be just, acknowledge that medicine then and medicine now are two very different things. What was the origin of the healing art, and what is the difference in its practice now from what it once was? In the early ages the whole population may be said to have been doctors. Real knowledge of medicine there was none. The parents tried their best to heal their offspring; the children endeavoured to ease the sufferings of their parents. In war or in the chase, companion helped companion. Soon, however, a sect or class arose of those who were more especially successful, or at least appeared to be more successful, in treating accidents and disease than the generality of people. Thus, gradually and almost insensibly, the people came to look upon this class as possessed of powers not given to every one. If you visit the savages of to-day you will find a class of practitioners as exclusive as our own, but you will also find that they have far more power and influence than doctors possess in this country. You do not meet with people who try to treat themselves.

Wherever power is attributed, the holder of the power becomes of necessity autocratic, and so, as the ages rolled on, persons possessing medical training became more and more exclusive, until in the middle ages the professors of medicine were conceited, exclusive, and overbearing. Far different is it with the modern doctor. He has his faults, it is true, but on the whole, he acts for the good of his patient, for the welfare of the community, and for the advancement of the science to which he has devoted his life. I was reading the other day the opinion of your celebrated townsman, Sir J. Simpson. Permit me to quote a few words of his on the medical profession. He says:—"The profession is in

many respects the most important secular profession which a man can follow. Its importance depends on the priceless value of the objects of the physician's constant care and study, namely, the guardianship of the health and of the lives of our brother man, and the defence of the human body and human mind against the attacks and effects of disease. Other pursuits become insignificant in their objects when placed in contrast with this. . . . What, after all, are machinery and merchandise, shares and stocks, consols and prices current, or the rates of cargoes and cattle, of corns and cottons, in comparison with the inestimable value and importance of the health and the very lives of those fellow-men, who everywhere move and breathe and speak and act around us? What are any, or what are all of these objects, when contrasted with the most precious and valued gift of God to earth—human life?"

It is because to us is committed the guardianship of this precious gift, that we appreciate more than others can, the gravity of errors arising from ignorance or prejudice, in matters relative to what we might almost call the sacred science of medicine. For this reason I have to-night drawn your attention to this subject, and I hope that what I have said may stimulate your thoughts, and that some of the hints thrown out may prove of use to you hereafter.

And now, ladies and gentlemen, I have done. I feel that my treatment of this subject has been inadequate. I know I have left unsaid much that I ought to have said, and said perchance some things which would have been better unsaid. I cannot help it. It has been only with great difficulty that I have been able to address you at all to-night. I have had unexpected claims upon my time. Do not, however, let my shortcomings tell upon those who follow me. The good wine is often reserved to the last; and from what I know of those who are to address you subsequently, I am well assured that this will be the case now.

HOW TO MAKE CHILDREN HEALTHY AND HAPPY.

By ALICE J. S. KER, M.D.

In beginning the consideration of this subject, we may lay it down as an invariable rule, that children will never be healthy unless they are happy, and will never be happy unless they are healthy. The time of childhood is the time, of all others, when a human being has a right to be simply, thoroughly, unreasoningly happy, and anything which interferes with his being so is to be resisted on the double ground of morals and of hygiene. When we consider how very small a matter will make a child perfectly happy, and how easily an equally small matter will plunge him into the depths of childish despair, we do well to pause and consider whether we have qualified ourselves for the precious care of the health and happiness of the beings who are confided to so many of us, in one capacity or another.

Every one will agree that it is the duty of parents to provide for their children in so far as they can do so, and that the man who squanders his substance and so leaves his children destitute, is very much to be blamed by the rest of the community. But in these days of keen competition, with over-crowded towns and over-worked brains, when every nerve has to be strained, even to retain the same position and avoid losing ground, we are all in need of the reminder that health is in itself the most valuable kind of wealth, and that we have no more right to squander it, even in good works, than we have to give away all our money, and so leave our children destitute. Each of us has received a certain proportion of health, greater or less, according as our ancestors have saved or squandered their share, and it is our solemn duty to hand on that health, increased, if possible, by

careful management, to the generation which is to follow us. In the same way, each child is born into the world, endowed with a certain amount of health, and it is the responsibility of parents and guardians to see to it that every means shall be taken to increase this share, and anything which diminishes it should be regarded as a robbery of the child of its birthright.

That many children are constantly robbed of their precious birthright of health is seen too plainly in the lanes and alleys of our cities, and is emphasised by the knowledge of the fact that one child out of every five born dies within the first year of life, and one out of every three within the first five years. It is true that some children survive and grow up, apparently healthy and happy, in the midst of surroundings which seem the very reverse of what they ought to be, but it is equally true that in too many instances, even when a certain amount of intelligent care is exercised, some one or more of the fundamental laws which lie at the root of all physical things may be unknown or neglected, and the consequence may be premature death or life-long misery.

The object of this lecture is to point out some simple ways in which the child's health, and, therefore, his happiness, may be secured most effectually; the hints being intended to apply to the existing state of things, not to ideal conditions which we should all like to see established.

In the forefront of all must be placed the question of cleanliness, the neglect of which probably produces more diseases than any other single cause, and, from the first moment of birth, its beneficial action may be made to work. It is not so generally known as it ought to be, that many children who are said to be "born blind," have really been born seeing, and that the blindness has resulted from neglect during the first days of life. The eyes of a new-born baby should be carefully washed with a clean, soft linen rag before anything else is attended to, great care being taken, in the washing, not to introduce into the eyes any of the matters which are being wiped off. Afterwards, the eyes should be carefully looked at every day, and shown to a doctor at once, if any inflammation or so-called "cold" should be observed. It is a very small amount of trouble to prevent such a sad affliction as life-long blindness. But the advantages of cleanliness are not confined to the eyes, or to very young babies. It must be

observed, as strictly as possible, all through the child's life. In these days of scientific teaching in the Board Schools, every one knows, or has a chance of knowing, something about the construction of the human body, and so it is not so necessary, as it once was, to give special explanations of the structure of such an organ as the skin. Most people know that, instead of being merely a covering envelope, the skin is made up of most wonderful structures, each of which has got some special work to do in the organism, and the principal of which are the sweat glands, which withdraw poisonous matters from the blood, and pour them out on the surface, to be removed. But if this removal of poisonous matters is to be carried on properly, the tiny openings through which they are discharged must be kept free, and the skin itself must be carefully preserved in a thoroughly healthy condition. The chief ways in which this can be done are frequent washing and frequent rubbing. The skin, especially of a growing child, should be washed all over with warm water and soap once at least in the twenty-four hours, when children have to live in a town, with all its smoke and dust. There is no doubt that cleanliness is more natural to children than dirt. No one can doubt this who has watched a child in the full enjoyment of a warm bath, which is a universal source of pleasure when the water is the proper temperature, the soap not too harsh for the skin, and loving care exercised in the scrubbing. The daily washing with warm water is more advantageously performed at night, both because it acts as a soother to induce sleep, and because it is then the most effectual, as the body will have from eight to ten hours of cleanliness in bed before the dust of a new day begins again. But in order to keep the skin in good condition, some care must be given to the selection of the soap with which it is to be washed. Unless the water is extremely soft, the ordinary yellow soap is too harsh for the skin — it contains too much alkali, and makes it *too* clean, removing not only the dirt which is foreign to it, but also the natural oiliness which is intended to keep it supple, and prevent its drying up. There are a great many different soaps of various kinds in the market, what are called "super-fatted soaps," all more or less expensive; but white curd soap is sufficiently mild for all ordinary use, and it is not any dearer than common yellow

soap. Soft soap should never be used for washing children's skins, except under medical orders in certain skin diseases. A brief mention may be made in passing of the necessity for making a child's skin perfectly dry after washing, especially in the folds where two surfaces touch each other. A little time spent in drying with a soft towel, may save much time afterwards in healing the chafing which the moisture will cause if left to dry itself on the skin.

The food of children has got very much to do with the preservation of their health and happiness, and, therefore, it must not be neglected in this lecture. For very young infants, the proper food is that provided by Nature, and this should be given as far as it is possible, even if artificial feeding has to be resorted to in order to provide a sufficiency. Where the child is brought up "by hand," the very strictest cleanliness must be observed in the management of the vessels in which the food is prepared, and it may be necessary to mention, as an important detail, that the feeding-bottles used should never be those with long india-rubber tubes, as it is almost impossible to keep them clean. The old-fashioned, boat-shaped bottles, with a hole at the side for filling, are very much more healthful, and should always be preferred. As children grow older their food must become more solid, but the same care must be exercised in maintaining strict cleanliness, and the food must be simple and wholesome. Much sugar should be avoided, except what is found in natural, ripe fruits, and very little butcher meat should be eaten by children of any age. It is unnecessary to say that alcohol in any form should be shunned as a poison, and even the stimulants of tea and coffee are very injurious. Strict regularity in the hours of meals is necessary for the complete health of a child, and no meal should be taken in a state of exhaustion from either bodily or mental work. There is not time or opportunity to enter more fully here into the subject of children's food, but these few hints may give sufficient foundation for the building up of a system, special care being always taken to ensure cleanliness and suitability.

The cleanliness which is so important for the skin and for food, is hardly less so for the clothing of the child; and frequent changes of the garments worn next the skin are absolutely essential for preserving health as it ought to be preserved. This brings us to the consideration of the proper clothing for children, which is

a very important factor indeed in their happiness. The dress of very little babies certainly leaves a great deal to be desired. The innumerable little garments, each of them covering only a small fraction of the child's body, are troublesome to put on, necessitate a great deal of turning of the baby over and over in the fastening of them, and are troublesome to keep clean. The long trailing robes which hang over the feet, and press on the toes, are hampering to the child's movements; and I have very little doubt that the discomfort which they cause when baby wants to kick his legs, is a very frequent cause of fits of crying. It would be very beneficial if the long outer robes were given up altogether, unless for some state occasion such as a christening, when one might be worn for a few minutes, and their place taken by dresses of the length which used to be called "half-shortened,"—only just long enough to cover the feet and keep them warm. The under garments should be fewer in number, warmer in texture, and more easily fastened than they are at present. As the child grows older, he will require more and more freedom for the movements of the limbs, and the dress must be more and more adapted to those conditions. He will also be more exposed to changes of temperature, and must, therefore, be clothed in the way which will enable him most successfully to resist them. For all these purposes, the best material in which to clothe a child is wool. It is warm, light, and porous; it does not get so soon clogged with dust and other impurities as calico; and by its special power of not conducting heat, it prevents changes of temperature from being felt as chills. Another very great advantage which it possesses, especially when considered as a dress for children, is its non-combustibility. When calico catches fire, it blazes up like a piece of paper, and, as sad accidents too often remind us, when a child ventures near a fire in a calico garment, the danger of serious burning is very great indeed. But when a light is applied to a woollen texture, it does not burn, but only smoulders, and its different parts have to be applied successively and continuously to the flame before it can be completely destroyed. When children are left alone, then, if at no other time, they should be dressed in nothing but woollen material, so that the fearful accidents by fire may no longer be possible. It is not so necessary now, fortunately, as it used to be, to speak against the fashion of leaving the arms and

necks of little babies exposed to the air. Mothers are becoming much more sensible in this respect, and wisely so, for the arms of little children bear the same proportion to the rest of their body that ours do, and we all know how unpleasant, and even painful it is, to have the arms uncovered in very cold weather. Fashion is now much more healthful than it used to be, too, in the matter of stockings, and children can now have their legs covered up from the cold, instead of shivering in short socks. But while scanty clothing must be avoided, a word of warning may not be amiss on the subject of too much clothing and coddling. To over-burden a child with garments, especially if they are heavy, and to make him feel too hot to move about freely and rapidly, is to weaken the skin so that it will not be able to discharge all its duties properly, and when a chill comes upon it, instead of acting promptly to resist it, the enfeebled muscles and glands will succumb, and "a cold," if nothing worse, will be the result. This applies specially to the custom of winding thick woollen comforters round and round the necks of little children, so that all the moisture and gases from the skin are confined close to it, instead of passing away into the air, and sore throats are cultivated, instead of being guarded against. The boots and shoes of children are also most important matters from the point of view of their health and happiness. One of the most painful recollections of childhood is the squeezing of chilblained toes, on frosty winter mornings, into stiff leather shoes, just a little too narrow across the toes; and these are the recollections of a childhood where the hygienic clothing of the feet was attended to with special care. Where such care is impossible, or is not regarded as necessary, I have no hesitation in saying that little children frequently endure a veritable torture of the boot. The proper shape of the human foot is that of a wedge, with the narrow end at the heel, the toes being far broader than any other part. But we may search through one shoe-shop after another without finding one single shoe which follows this outline, although some may come a little nearer to it than others. The difficulty of procuring properly shaped shoes makes them an impossible luxury to poorer families; but if those who can afford to have them made as they choose would awake to the necessity of making the shoe to fit the foot, instead of having the foot forced to mould itself to

fit the shoe, they would help not only their own children, but those of their poorer neighbours, as properly shaped shoes might then have a chance of becoming fashionable. Until that happy time arrives, we must all do our part, as best we can, by insisting upon having the broadest toes procurable, and by spreading the doctrine as widely as we can.

The question of shoes brings us naturally to that of exercise, which is not one of the least important heads of our subject. Exercise, and very lively exercise too, is natural to all young animals. Its use is to stimulate the muscles and joints to be more firmly knit together, to set the blood circulating more vigorously throughout the whole body, and to excite brain and nervous system generally to constantly renewed activity. It is one of the invariable rules of Nature that anything which is necessary for the well-being of the individual is also pleasurable, and so it is that young creatures, whose bodies need the exercise more than adults, find more pleasure in taking exercise. This need for almost constant movement begins after the first few weeks of life, and it ought to be as much encouraged in the infant as in the child who can walk. As soon as a baby is old enough to want to kick on his nurse's lap before the fire, he ought to be allowed to do so, and five or ten minutes should be devoted to this as regularly as to the daily walk which he will take when he grows older. As months and years advance, exercise will become more and more necessary to the child, and it will become a positive cruelty to oblige him to remain perfectly still for long at a time On this account, the occupations of little children should be arranged in such a way as to include a great deal of motion, so that they may have what is necessary to them in a legitimate way, without being obliged to break arbitrary rules in order to get it. When children grow older still, there is generally no difficulty in obtaining sufficient exercise for one section of them—the boys, but it is necessary to put in a special claim for a sufficiency of exercise for girls. Playgrounds and gymnasiums are provided largely for boys, but girls are still too often expected to find sufficient recreation in mending their own and their brothers' clothes, with an occasional turn at the skipping-rope. It is necessary to speak a word of caution, however, against making this recreative exercise compulsory, for it should not be allowed

to degenerate into a task. Some kind of physical training, in the way of gymnastics, may form a part of the school curriculum, but a comparatively large amount of time must be left free for spontaneous enjoyment; and when girls' schools are arranging for physical exercise, they must be careful to avoid falling into the same errors as the boys' have done. Childhood, as we have said, is the time for unreasoning enjoyment and happiness, and we must not spoil it by making a task out of what ought to be only a pleasure. It will be a great benefit to the race, as well as to individuals, when this necessity for exercise for girls as well as boys has been thoroughly inculcated in our minds; and I am far from jesting when I add that it would diminish the temptations of young men and the toils of young women, and add to the happiness of both, if boys were made capable of doing their own mending.

This brings us, by an easy transition, to the question of the occupations and recreations of children; and that again is included in the term discipline. The discipline of a child may begin at the very earliest age, and it must then be carried out by the very simplest means. No time is too soon to begin to train an infant into those habits of self-control which will be so much needed in after-life. Those of us who have spent any thought at all on life and its mysteries, must have seen and realised that the one virtue, of all others, which is most necessary to us, is that of self-control, and some of us have found that we have had to acquire it for ourselves at the cost of much suffering. When we realise this, we must acknowledge that, when we have taken the solemn responsibility of bringing new beings into the world, it is our duty to fit them for their life's work by helping them from the first to gain control over themselves. The only way in which we can discipline a very young infant is by regulating its times of feeding. This, however, is a very important thing, and if it is strictly attended to, it will be found to have a wonderful influence both on body and mind. Every two hours at first, and afterwards every three hours, with a longer interval during the night, is quite frequent enough for a baby's meals. But the mother or nurse must exercise some intelligence and care to find out whether the child's cries mean hunger or some other discomfort. We are all too ready, when a child shows signs of uneasiness, to answer all his complaints by giving him food, being too lazy or too stupid

to learn for ourselves, as we easily may do if we are sufficiently observant, whether he is trying to express hunger, or a feeling of discomfort or pain from some other cause. We think we are justified when we see the child respond eagerly, and try to take the food, never reflecting that the reason is that he has not yet learned what all the different sensations mean. And here a word of warning is needed to mothers who are nursing their children, and who may not be aware how much the state of their own health, and even temper, may affect the health of the child. Cases have been known in which a mother has indulged in an outburst of passion just before nursing her child, with the result that the perfectly healthy infant has had a fit of convulsions, and has even died, the passion in the mother having converted the milk into a virulent poison. There is no doubt that smaller degrees of emotional disturbance will have a more or less injurious influence, which may affect the child in similar ways. As children grow older, discipline may be more directly inculcated, and the chief point which I should like to emphasise here is that children who have been brought up according to all the rules of health are really fonder of what is good than of what is bad for them. Properly brought up children, for example, really enjoy plain food, and regular hours, and frequent washing, and abundant exercise; and nothing is more foolish than to inflict on a child, as a punishment, some observance of the laws of health which ought to be a matter of choice. We all need to exercise much more discrimination than we do in the distribution of rewards and punishments. So far from being arbitrary, they ought to have as close a relation and consequence as possible to the actions which have called them forth. They ought to appeal also to the higher and not to the lower levels of the child's nature—to the unspoiled generosity and nobility which exists in every little child before he has been taught the so-called wisdom of life, and, as the thoughtful author of "Scientific Meliorism" has pointed out, the worst thing that we can do is to reward or punish a child by appealing to the pleasures of the appetite and palate. To punish by depriving of some specially favoured dish, and to reward by bestowing some sweetmeat which is withheld from the less deserving, is to cultivate assiduously the very side of the child's nature which ought to be

kept in its proper place in the background, and to weaken instead of to strengthen him for the battle of self-control which all must fight. In these modern days it is no longer the tendency of education to make all work and duty disagreeable to children, and to consider that they are sinning by being happy, but we are certainly not doing enough to train children to relf-reliance and self-control, and so we are pulling down with one hand what we are building up with the other. This is not the occasion on which to enter into an elaboration of a system of education, nor is it the work of a physician to do so. My business is to point out the defects in the prevailing manners and customs, and to try to make clear the way in which these defects act. There is only time for laying down a few simple general rules. In the first place, no children under the age of twelve should have their minds occupied in strictly mental work for longer than four hours a day, and very young children should not have half that time. We must not lose sight of the physiological fact that an enormous proportion of the brain force of a child is required for building up his rapidly growing body, beside the large amount used up in repairing the wear and tear of each day, so that very little remains available for mental efforts, without encroaching on the capital, so to speak, which ought to be available for after-life. When too much work is thrown on the brain, the conservative instincts of Nature come into play, and the brain, in the most fortunate cases, ceases working, saving the child from the consequences of waste of nerve force, but encouraging a habit of inattention and trifling, and of systematic neglect of arbitrary rules. It is a fatal thing when a child has to choose, either consciously or unconsciously, between the laws of Nature, which are those of Nature's God, and the arbitrary laws laid down by those in whose hands he is so absolutely helpless. The element of worry, too, so trying even to full-grown, adult brains, is not left out of a child's life, as it ought carefully to be, but exists largely in connection with the system of marks, competitions, and prizes. Both from a moral and a hygienic point of view, these are to be utterly condemned. They induce a habit of doing work, not for its own sake, but for what it will bring in the way of reward; they make the standard to be attained, not the child's best, but something which is a little better than some one else can do; and

they cultivate a spirit of desiring to injure his neighbour, instead of the eagerness to help which we ought to seek to inculcate. From a hygienic point of view they are to be condemned because they induce too much work, and, as I have said, the element of worry.

I cannot end better than with the words of Herbert Spencer, in his "Moral Education:"—"Is it not manifest that as 'ministers and interpreters' of nature, it is the function of parents to see that their children habitually experience the true consequences of their conduct—the natural reactions; neither warding them off, nor intensifying them, nor putting artificial consequences in place of them?"

THRIFT, IN REGARD TO HEALTH AND WEALTH,

WITH SPECIAL REFERENCE TO FRIENDLY SOCIETIES.

By DAVID PAULIN,

Manager of the Scottish Life Assurance Company.

Ladies and Gentlemen,—When I had the honour of being asked to address your Society, it was suggested to me that it would be an agreeable variety to a large section of the membership to have as a parenthesis to the Medical Lectures—interesting as these have always been—a Lecture which would treat of some of those social and economic subjects that bear directly at almost every point on the every-day life and well-being of the wage-earning classes. Looking at the list of objects which our Society was formed to promote, I cannot but express my surprise that subjects of this nature have not hitherto had a place in each winter's programme, and my regret that the inauguration of the new departure has not fallen into the hands of some one who could better and more capably interest and instruct you.

It is my conviction that this Society, which in other directions has done so much, would perform a most helpful and much needed service to thousands of the working men of Edinburgh and their families, if they would devise and carry out a course of instruction on the systems of Thrift, real and counterfeit, which exist in our midst, and the principles of mutual help and brotherhood which underlie many of them. In this way the schemes that are worthy would flourish and endure, while, under the light of publicity and discussion, those that are otherwise would wither away and disappear.

I propose to direct your attention to-night to several points bearing upon the earnings, spendings, and savings of the wage-earning classes; and in order that you may have a better understanding of the position from which I approach the subject, I shall begin by trying to define the meaning of the three words, Thrift, Health, and Wealth, which appear in the title of this Lecture.

What is Thrift?

Among the many derivations which have been given to me of this old Saxon word, that, to my mind, most correct, and most appropriate to our subject to-night, is one drawn from a very ancient source, from the Sanskrit word TRI, having this interpretation—to go beyond, to shoot ahead, to pass. This, you will perceive, is somewhat opposed to the meaning generally attached to the term in the present day. Thrift in our common acceptation of the term would seem to imply a parsimonious mode of life—living cheaply in order to hoard. But true Thrift has a wider range and a deeper meaning. The man who thrives is not a miser, neither is he a mere economist. He is one who is ever rising higher, striking out more broadly, and by eschewing present gratification, attaining to independence, and the esteem and love of his fellow-men. He saves money only as a means to a noble end. Emerson thus describes Thrift:—"It is a high humane office, a sacrament when its aim is grand; when it is the prudence of simple tastes, when it is practised for freedom or love or devotion. Much of the economy which we see in houses is of base origin, and is best kept out of sight. Parched corn eaten to-day that I may have roast fowl to my dinner on Sunday is a baseness; but parched corn and a house with one apartment, that I may be free from all perturbations of mind, that I may be serene and docile to what the God shall speak, and girt and road-ready, for the lowest mission of knowledge or goodwill is frugality for Gods and heroes." George Herbert, who has dignified his age by his wise and beautiful thoughts, bequeathed to us in quaintest verse, says:—

> "Be thrifty, but not covetous; therefore give
> Thy need, thine honour, and thy friend his due.

Never was scraper brave man. Get to *live*,
Then live, and use it; else it is not true
That thou hast gotten. Surely use alone
Makes money not a contemptible stone."

George Herbert is right. True Thrift keeps money in its right place, and makes it a stone—a stepping-stone—to higher things. And now,

What is Health?

A commodity that is too often under-valued till it is lost. It is a greater blessing than wealth. Pope's well-known couplet says:—

"Reason's whole pleasure, all the joys of sense
Lie in three words—health, peace, and competence."

One poet describes it as "rising in the morning to new-found joy and vigour;" another says, "Health is the vital principle of bliss." It is, I think, that learned physician of bygone days, Hippocrates, who describes health as "a sound mind in a sound body." Montaigne writes—"Health is a precious thing, and the only one, in truth, which merits that a man should lay out, not only his time, sweat, labour, and goods, but also his life to obtain it, forasmuch as without it life is a burden to us." No definition that I have seen approaches in felicity of expression that given by the present distinguished President of the Royal College of Physicians—"A state in which the body is not consciously present to us, in which it is a joy to see, to think, to feel, to be; the state in which work is easy, and duty not over-great a trial; the state in which one goes forward on the journey of life getting and giving joy."*

What is Wealth?

Wealth is the overflow of the means of life and enjoyment. It is, as the word signifies, a state of weal or well-being. To be wealthy it is not needful to be possessed of fortune as represented

* Sir Andrew Clark, in this connection, has another pregnant sentence—"The most solemn truth which my profession has taught me is that nature is implacable. She never forgets and she never forgives. This is a hard truth especially to the young. It has for its companion the pleasanter truth, that the moment we resolve to pay the price of good health—to deny ourselves, to obey the laws of health—everything begins to go right."

by real estate, consols, or other investments, or even by a large income. The man whose weekly wages do not exceed twenty shillings may be in the truest sense of the word a wealthy man, so long as his wants or desires are covered by his means, and, after having "looked the whole world in the face, for he owes not any man," can spare a portion of his earnings for his future wants or for the wants of others. It is well to bear in mind the distinction between a wealthy man and a rich man. A miser may be rich. He has money, but it is not useful to him or used by him—it is in his case a curse, and not a blessing, therefore it is not for his welfare—he is not wealthy. A wealthy man knows how to use money. He observes in due proportion the three good rules—Make all you can; Save all you can; Give all you can. How often are the first two of these rules observed, and the last unregarded! There is a story told of a clergyman who, on one occasion, preached a very practical sermon from these heads. Among his hearers there was an old farmer, notorious for his miserly habits. When the minister enforced the duty, "Make all you can," by being diligent in business, careful of littles, and so on, the farmer was quite delighted. "He had never heard the minister that he liked him better." Still more delighted was he when the second head was enjoined, "Save all you can," with reasons annexed—"It was just what he had aye done himsel';" but when the third head was announced, and the preacher exhorted his hearers to "Give all you can," the farmer's approving countenance fell, and with a wry face he ejaculated, "Man, he's gane and spiled it."

Our national poet, Burns, gives a happy definition of what ought to be wealth's aim and object, in the following well-known lines:—

"To catch Dame Fortune's golden smile,
Assiduous wait upon her;
And gather gear by every wile
That's justify'd by Honour;
Not for to hide it in a hedge,
Nor for a train attendant;
But for the glorious privilege
Of being independent."

It is a fundamental proposition of political economy that all existing capital has been created by savings from the produce of

labour. Thousands of our fellow-countrymen in days past have, by well-directed labour and enterprise, made or produced more than they needed for their personal wants, and by laying aside a portion of these earnings, have contributed to the creation of that vast wealth which has made Great Britain the richest of all the nations of the world. The increase of the national wealth since the beginning of this century has been truly marvellous. Even that portion of the increase which has taken place during the last twenty-five years is so vast as to carry us into the region of conjecture. The amount of property on which probate or succession duty was paid was,

in 1860, . . .	£95,000,000.
in 1870, . . .	125,000,000.
in 1880, . . .	153,000,000.

Now we know that on an average two per cent. of the population die yearly, so that, if we multiply these amounts by fifty, and add ten per cent. as representing estates that are exempt, we arrive at the accumulated wealth of the nation, which would thus be,

in 1860, . . .	£5,200,000,000.
in 1870, . . .	6,880,000,000.
in 1880, . . .	8,420,000,000.

Statisticians who have given this subject special attention estimate the national wealth at the present time at not less than £10,000,000,000. During the first half of the above period the accumulations averaged close on £550,000 a day (Sundays excepted). During the second half about £500,000. If we take the medium population for the whole period as 30,000,000, we find the average savings per day to be at the rate of 4d. for each inhabitant.

Increased Earnings of Working Men.

I think it is capable of demonstration that this great increase of wealth has been distributed among all classes of the community. The proof is overwhelming that the working classes have advanced in material prosperity to a very great extent during the reign

of Queen Victoria. Hours of labour have been lessened, notwithstanding which money wages have increased, and concurrently with this, there has taken place a considerable fall in the price of many of the commodities which workmen require for their sustenance and use. It is also a matter for congratulation that the rate of mortality and the rate of sickness have both decreased, thus giving greater strength to labour and greater length to life. Malthus and his disciples were afraid that the population of our country would increase at a greater ratio than the means of subsistence. How singularly their predictions have been falsified! Side by side with an increase of population unprecedented in the experience of any old country, there has been produced the means of subsistence greater in quantity and better in quality for all the new-comers who are willing to work. This country stands deservedly high for the character of the work produced in its looms and forges and workshops. There is no doubt a close connection between good health, good work, and good wages. A story may illustrate this better than a logical demonstration. A weaver had a stingy wife, who, in false economy, nearly starved him. One day, as he dawdled through his web, she heard him humming away the refrain, "Half a herrin' and half a scone, half a herrin' and half a scone." With an inspiration which was greatly to her credit, she doubled his allowance, and to her delight she saw her weaver next day driving the shuttle at a greatly increased rate to the tune, "A scone and a herrin', a scone and a herrin'." Seeing the good effect of her first experiment, she again increased the allowance, and this time the weaver actually made the shuttle fly, and got through three times the work, while he merrily sang, "A scone and a half and a herrin' and a half, a scone and a half and a herrin' and a half." It is reasonable to suppose that the shortening of the hours of labour and the better remuneration given for it may have improved the quality of the work, and thus that the employers have suffered nothing by the change, while the workmen have been greatly benefited.

I think it is possible to establish the position that the present generation of working men, if willing to save, ought to be able to do so, owing to the great increase in money wages which has taken place during the last five decades. I had the opportunity

of hearing two singularly able papers on this subject read before the Statistical Society of London by Mr Giffen, the Statistician to the Board of Trade, in which he showed that the working classes are, on the average, twice as well off to-day as they were fifty years ago. His conclusion was—"The improvement is at least between 50 and 100 per cent., and, with an allowance for the shortening of the hours of labour, may be placed nearer the 100 than the 50, if not over the 100." One of the tables he submitted in his paper read in 1883 showed a comparison of the weekly wages at the two periods, and the percentage of increase which had taken place :—

Comparison of Wages Fifty Years Ago and at Present Time.

Occupation.	Place.	Wages Fifty Years ago, per Week.			Wages Present Time, per Week.			Increase per Cent.
		£	s.	d.	£	s.	d.	
Carpenters	Manchester...	1	4	0	1	14	0	42
,,	Glasgow	0	14	0	1	6	0	85
Bricklayers...	Manchester*..	1	4	0	1	16	0	50
,,	Glasgow	0	15	0	1	7	0	80
Masons	Manchester*..	1	4	0	1	9	10	24
,,	Glasgow	0	14	0	1	3	8	69
Miners	Staffordshire	0	2	8†	0	4	0†	50
Pattern weavers	Huddersfield	0	16	0	1	5	0	55
Wool scourers	,,	0	17	0	1	2	0	30
Mule spinners	,,	1	5	6	1	10	0	20
Weavers	,,	0	12	0	1	6	0	115
Warpers and beamers...	,,	0	17	0	1	7	0	58
Winders and reelers	,,	0	6	0	0	11	0	83
Weavers (men)	Bradford	0	8	3	1	0	6	150
Reeling and warping	,,	0	7	9	0	15	6	109
Spinning (children)	,,	0	4	5	0	11	6	160

In his more recent paper he devoted considerable pains to prove that the increase had taken place in the wages of the lowest class of labour also. He produced elaborate tables in confirmation of this statement. The following are some of the particulars :—

* 1825. † Wages per day.

WAGES OF UNSKILLED LABOUR (NON-AGRICULTURAL) FIFTY YEARS AGO AND AT THE PRESENT TIME.

	Fifty Years Ago.			Present Time.			Increase Per Cent.
	£	s.	d.	£	s.	d.	
Labourers, London	0	15	0	1	5	0	67
,, Bradford	0	15	0	1	1	9	50
Bricklayers' labourers, Manchester	0	12	0	1	2	0	83
Spademen, Manchester (maximum)	0	15	0	1	2	0	50
Bricklayers' labourers, Glasgow	0	9	0	0	18	0*	—
Stocking makers, Leicester	0	8	3	0	14	0†	70
Labourers, Londonderry	0	8	0	0	16	0‡	100

According to Sir James Caird, the average rise in the wages of agricultural labourers has been about 60 per cent. during the last forty years. The following extract from a letter from John Bright, published in the *Times* for 18th November 1884, is of importance in this connection:—"As to wages in Lancashire and Yorkshire, the weekly income of the thousands of factory workers is nearly, if not quite, double that paid before the time when Free Trade was established. The wages of domestic servants in the county from which I come are in most cases doubled since that time. A working bricksetter told me lately that his wages are now 7s. 6d. per day; formerly he worked at the rate of 4s. per day. Some weeks ago I asked an eminent upholsterer in a great town in Scotland what had been the change in wages in his trade. He said that thirty or forty years ago he paid a cabinetmaker 12s. per week; he now pays him 28s. per week. If you inquire as to the wages of farm labourers, you will find them doubled, or nearly doubled, in some counties, and generally over the whole country advanced more than 50 per cent., or one half, while the price of food and the hours of labour have diminished." The late Professor Leone Levi stated a few years ago that in the seventeen years—1867 to 1884—the aggregate annual earnings of the working classes had risen from 418 millions to 520 millions sterling, or nearly 25 per cent.—the increase in the number of workers being only 11 per cent.; and the average increase per

* 48 hours weekly, at 4½d. per hour.

† Lowest wage quoted for Leicester. ‡ Dublin.

head is from £38 to £42, 14s., or rather more than 11 per cent.

The foregoing evidence proves conclusively that the condition of working men during the last two generations has been a progressively thriving one in regard to money wages.*

In many other respects their condition has been ameliorated and chief among these we would place the shorter hours of labour and the greater security and independence which they now enjoy. There is a considerable diversity of opinion as to the main causes which have led to this. Some men favour the idea that it is due almost wholly to the introduction of Free Trade. Others again attribute it to the invention of machinery, the application of steam power in our industries, the development of our coal and iron measures, and the marvellous changes that have taken place in the carrying trade of the country.

There can be no doubt that all these have been important factors in increasing the wealth of the nation. I think, however, that the working men of this country are indebted, to no inconsiderable extent, for securing to their own order their share in this increase of the national wealth, to a movement which took its

* From many friends interested in large works in and near Edinburgh, I have received confirmation of the facts stated by Mr Giffen. The following figures give the wages paid at large Paper Works near Edinburgh in 1838 and 1888 :—

	1838.	1888.
Women Working amongst Rags —		
Maximum,	6s. 6d. per week.	11s. 6d. per week.
Minimum,	3s. 6d. ,,	6s. 0d. ,,
General, -	4s. 6d. ,,	8s. 0d. ,,
Women Working amongst Paper—		
Maximum,	5s. 6d. ,,	14s. 0d. ,,
Minimum,	3s. 6d. ,,	5s. 6d. ,,
General, -	4s. 6d. ,,	10s. 0d. ,,
Men—		
Maximum,	17s. 0d. ,,	30s. 0d. ,,
Minimum,	10s. 0d. ,,	12s. 0d. ,,
General, -	13s. 0d. ,,	18s. to 21s. ,,

The wages of skilled engineers and foremen are not included in these figures.

rise from among themselves—I refer to combination, or as it is more popularly known,

Trade Union.

It is greatly to the credit of British working men that their efforts to obtain the right to combine—though the fight had to be maintained for long years against a tyrannical and distrustful opposition— were conducted in the main by constitutional means, contrasting favourably with the revolutionary and socialistic methods of workmen in other European countries to attain the same end.

Those who know the dependent position in which labour formerly was, the low rate of wages in many trades, and the terrible state of distress and helplessness to which workmen were reduced when thrown out of employment in times of depression, will understand the blessing which these organisations have been to them. In studying the history of labour combination, one is appalled at the state of wretchedness into which workmen were plunged in consequence of unfair laws which abandoned them to the discretionary power of the employers. For instance, a number of workmen who signed a petition to Parliament were discharged. Even a peaceful meeting to discuss the rate of wages rendered workmen liable to a penalty of three months' imprisonment. The masters could combine to reduce wages without the law touching them, while the workmen frequently suffered imprisonment for their combinations to raise wages. A law so severe and one-sided had its natural effect in promoting secret combinations and provoking acts of violence. Strikes were of frequent occurrence and led to acts of an atrocious description.

There are two black pages in the history of labour combination. The one is the unreasonable distrust of the working classes on the part of the legislature, and the other is the unwise manner in which the workmen in some instances used their liberty shortly after they had obtained it. Happily these conditions have passed away. The composition of the legislature has greatly improved, and its attitude towards the working classes has become much more favourable; while, on the other hand, the Unions have outlived the prejudice which their conduct at first excited against them. To evade the Act against trade combinations these Trades Unions, before they became legalised, called themselves benefit societies, though their real object was to fight for better

wages and conditions. Now that they are legalised, though they take the name of Trade Unions, the figures in their annual reports would lead one to infer that the main reason of their existence is for Friendly Society purposes, and that trade polemics now form a subsidiary object. For the most part the men who have been honoured with the confidence of their fellow-workmen in carrying out the work of the Unions have been well-informed and judicious men, and have conducted the business entrusted to them with consideration, honesty, and singular capacity. Instead of constant recourse to strikes as formerly, there is now reference made to boards of arbitration and conciliation, to the mutual advantage of both employers and employed. Strikes are regarded as necessary evils, alike injurious to the interests of capital and labour, to be resorted to only when every other means have been tried and have failed to effect a satisfactory agreement.

An indirect benefit of combination has been to teach the members what self-help and self-reliance may do. It has also protected them against many of the ills and misfortunes incident to industrial life, and has without doubt thus tended to avert social and industrial disorder.

Trade Unions in their Friendly Society Aspects.

It is surprising that these Trade Unions are not supported to a greater extent by the working classes, if not out of gratitude for the past successes they have won for their order, at any rate for the singularly favourable benefit returns they give to their members for a moderate contribution.

Although the subject of the benefits granted by Friendly Societies will be afterwards discussed, it may not be inappropriate, while we are treating of the subject of Trade Unions, to say a few words regarding them in their Friendly Society aspects.

The chief benefits which the leading Unions grant are—Accident and Sick Pay, Out-of-Work Pay, Old Age Pay, Benevolent Grants, and Funeral Allowances. In the larger Unions the Sick Benefit and Out-of-Work Allowance averages from 9s. to 10s. weekly. When a member is permanently disabled by accident from following his ordinary occupation, a grant of £100 is made to enable the injured member to earn a livelihood in some other

way. The Funeral Allowances payable on the death of a member vary from £7 to £12, and on the death of a member's wife, from £5 to £6. Superannuation Allowance is a benefit which many of the Unions have only lately undertaken to give. The weekly allowance under this head paid by the Engineer's Society is 7s. to 11s.; the Carpenters and Joiners give 7s. to 8s.; the Steam-Engine Makers, 5s. to 9s.; the Iron Moulders, 5s. 6d. to 7s.; the Boilermakers, 6s.; the Ironfounders, 5s. 6d.; and the Tailors, 2s. 6d. to 5s.

In the following table I have shown the disbursements under various heads by the seven Trade Unions above-mentioned, which may be taken as fairly representative of the better class of these organisations :—

TABLE SHOWING THE AMOUNTS EXPENDED ON THEIR VARIOUS BENEFITS BY SEVEN OF THE PRINCIPAL TRADE UNIONS DURING THE YEAR 1887.

Names of Society.	Number of Members. Dec. 1887.	Unemployed Benefit.	Sick Benefit.	Funeral Benefit.	Accident Benefit.	Superannuation Benefit.	Loss of Tools Benefit.	Trade Protection.	Benevolent Grants.
		£	£	£	£	£	£	£	£
Amalgamated Society of Engineers, . . .	51,869	80,458	31,138	9,021	1,850	36,163	129	4,858	2,989
Amalgamated Society of Carpenters and Joiners,	25,497	32,814	17,228	2,951	1,370	3,797	1,510	4,487	786
Steam-Engine Makers' Society, ...	5,080	5,989	2,729	745	100	1,714	...	1,051	49
Friendly Society of Iron-Founders, . . .	11,718	21,801	6,192	2,307	613	7,692	...	100	13
Society of Boiler-Makers and Iron Shipbuilders, .	25,100	22,165	20,539	3,452	1,815	4,657	...	1,131	...
Associated Iron Moulders of Scotland, . . .	5,455	8,908	...	1.843	...	3,073	...	...	...
Amalgamated Society of Tailors, ...	14,305	1,280	9,688	2,836	...	511	...	804	35
	139,024	173,415	87,514	23,155	5,748	57,607	1,639	12,431	3,872

It will be observed from this table that there are 139,024 members in these seven Unions. The contributions are at present—in the Tailors' Society, 7d. per week; in the Iron Moulders' Society, owing to special circumstances, so high as 2s. per week;

in the other societies, from 9d. to 1s. a week. The sum paid out for Friendly Society objects was £352,950; while the amount paid for Trade Protection or strike pay was only £12,431, being a little over 3 per cent. of the total amount expended.

In his recent address to the International Trade Union Congress, the chairman submitted statistics of twenty-six of the leading Unions of this country, and showed that during their existence—the mean time being twenty-three years—they had expended, from funds accumulated from hard-earned wages, the following large sums:—

For Unemployed benefit, . . .	£3,559,059
For Sick benefit, ...	2,006,539
For Superannuation, when incapable of work,	753,149
For Funerals of members and their wives, .	663,783
For upholding and increasing wages, and reducing hours of labour, ...	603,531
For Benevolent Grants in cases of special distress, and assistance to other tradesmen in difficulty,	168,888
For replacing tools lost or destroyed, .	84,333
For members travelling in search of work, .	17,144

Making a grand total of about eight millions sterling.

In his address he made out a good claim on the working men of this country to support the Unions. His concluding passage was as follows:—"When we can obtain wages from which it is possible—as it ought to be—to make effective savings, the sceptre of Industry will pass from the hand of the capitalist to that of the labourer, and not till then will industrial strife cease. Our higher life and truer enjoyment must be preceded by wider organisation of labour, sustained by regular contributions, directed by broad sympathies and enlightened confidence in each other, regardless of race, creed, or nationality; then this feeling, acting in sound economic medium, will make a vast and beneficial change in our industrial system, and give the material conditions of peace, happiness, and prosperity to the multitudes who earn their bread by their daily toil."

Let us now turn our attention to the second division of the subject, namely, the

Spendings of the Wage-Earning Classes.

It will be possible to make out a case that there should be some money to save and invest, if, in addition to proving that workmen now earn more money than they formerly did, we can show that the purchasing power of that money on the necessaries of life is now greater than it was in a former generation. The prices of commodities, which are in daily use in a workman's family, such as clothing, bread, sugar, tea, furniture, &c., are now less than was the case fifty years ago; while, on the other hand, the two items of house rent and butcher meat, have increased in price. The standard of living has, of course, risen considerably, and there is now more food, and that of a better quality, consumed in the houses of our working population. There falls naturally under the head of spendings, the consideration of a subject which cannot but call forth our thankfulness for what it has already accomplished, and at the same time inspire us with a great hope for what it may yet do for the working classes. I refer to

Co-operation.

This system of thrift has already been of immense benefit to working men, and it has potentialities of extending that benefit to tens of thousands of our countrymen who are still in ignorance of its beneficent usefulness and application to their circumstances.

The aim and determination of co-operators is to associate labour with capital, and while displacing competition to substitute therefor a great brotherhood, working for each other's good and the benefit of all. The form of co-operation which has been most successful in this country, is distributive co-operation. The system had flourished in England for many years before it took root in Scotland, but there are now very few villages or towns in this country which cannot boast of their co-operative society, conducted on the Rochdale principle, and doing a flourishing business.

The history of co-operation is one of intense struggle. The men who first originated the system in Lancashire—the Rochdale Pioneers—started their Society in 1844 with 40 members and a capital of £28, and it was in the face of many difficulties and

many a sneer that they began their work. After three years they had 110 members and a capital of £397, while their weekly turnover averaged £36. Their membership has now reached 11,084, their capital is £345,653, and their weekly receipts are £4920. The Society has enabled many men in that district to save and become possessed of considerable sums of money. By means of it, also, many thousands of men have become owners of cottage homes.

I speak of co-operative societies only as they exist among the working portion of the population, and such as are conducted on the Rochdale system. Their establishment struck against business usages and social arrangements that were productive of misery and poverty. Where adopted, they abolished the almost universal habit of buying on credit, and thus thrift has been promoted, and the impositions belonging to a credit system, with its bad debts and adulterations, have been avoided. All honour to the men who pioneered the system! They had tunnel work to do before they issued forth into the light and sunshine of prosperity, but now co-operation, in so far as distribution is concerned, is an admitted success, while its possibilities in other directions to help and bless its votaries wait but for a larger measure of the spirit of goodwill and brotherhood, and the education and enlightenment of the up-striving masses, in its power to raise and ameliorate their lot.

The membership of distributive co-operative societies has made rapid progress in recent years in Edinburgh. We may, from the facts and figures relating to one Society, learn something of the practice of all. The Society in Fountainbridge, which was instituted in August 1859, has now a membership of 5351, who possess a capital of £38,727. It appears that every member must subscribe for a £5 share, and pay for it in cash, or have the half-yearly bonus on his purchases, to the extent of 13s., applied to paying up his share till it amounts to £5. This is a lesson in thrift to commence with. Once paid, the share yields 5s. per annum of interest to the member. The system is to sell goods at the prices current in the neighbouring shops. The Society pays cash for its purchases, which are very large in amount, and thus it gets the best quality at the lowest price. Last half-year its sales amounted to £76,800, upon which it made

a profit exceeding £13,250, which sum it distributed as a dividend to its members on their purchases at the rate of 3s. 6d. per £1. It thus enabled its members to make 16s. 6d. go as far as 20s. would have gone without its aid. The dividend or bonus each half-year cannot but prove a great boon and a healthy lesson in thrift to its members. The Society is beginning to accumulate more money than is required for the distributive business. One method in which it utilises its surplus funds is to grant to its members loans, repayable by instalments, for the purpose of acquiring dwelling-houses. It has already granted thirty-seven of these loans to members, and enabled that number of families to become possessors of their own houses by payment of an annual sum for twelve or fifteen years (in redemption of principal and interest) very slightly exceeding the rent they formerly paid. The Society also takes deposits from its members, allowing interest on the money deposited.

There are other three flourishing co-operative societies in Edinburgh: the Bread Society, the Edinburgh Northern, and the Norton Park Societies. The total membership of the four societies in Edinburgh is 8559. The Edinburgh and almost all the other societies throughout Scotland purchase their goods from the Scottish Wholesale Society, in Glasgow—the net sales of which last year were £1,932,134. The Wholesale Co-operative Society in Manchester—which supplies most of the societies in the North of England—last year turned over the immense sum of £3,396,000. The share capital now invested in co-operative societies in this country is a little over £10,000,000. There are close upon 1,000,000 members. The sale of goods amounted last year to £24,723,285, yielding a profit of £2,357,635. These figures will give you some idea of the hold the system has taken on the working-men of Great Britain.

In 1865 John Stuart Mill wrote:—"Eventually, and in perhaps a less remote future than may be supposed, we may, through the co-operative principle, see our way to a change in society, which would combine the freedom and independence of the individual with the moral, intellectual, and economical advantages of aggregate production; and which, without violence or spoliation, or even any sudden disturbance of existing habits and expecta-

tions, would realise, at least in the industrial department, the best aspirations of the democratic spirit, by putting an end to the division of society into the industrious and the idle, and effacing all social distinctions but those fairly earned by personal services and exertions."

Co-operation at Home.

If I might say a word to wives, it would be that a man may have the power to save and the will to save, but he cannot succeed unless there is co-operation at home. The influence of the woman in the home is very powerful—it is ever at work ; and if a house is a true home, it is because there is a loving, self-denying woman making it so. The quality of gentleness is as frequently found in the cottage as in the mansion; and there are as many true gentlemen and gentlewomen in the homes of those who live by daily toil as in the castles of the rich and great. When a man has a good wife he goes forth to his work in the morning, and all through the day his work is a perfect joy to him. He realises what Burns says—

> "To mak' a happy fireside clime
> For weans and wife,
> That's the true pathos and sublime
> Of human life."

Many a man who has fallen under the baneful influences of evil habit and been "bird-limed at a tapster's bough," might have been saved, had the wife known the influence of a clean and bright fireside and a cheerful smile. It is said that "when Poverty comes in at the door, Love flies out of the window." It would be more correct to make Debt the culprit that chases Love away. The beginning of debt should be avoided like a plague. Whatever the income is, there should be a brave fight to make the expenditure somewhat less. Wilkins Micawber, though his practice differed sorely from his precept, was not far from the truth when he said: "Annual income, twenty pounds; annual expenditure, nineteen nineteen six—result, happiness. Annual income, twenty pounds; annual expenditure, twenty pounds ought and six—result, misery. The blossom is blighted, the leaf is withered, the God of day goes down upon the dreary scene, and—and in short you are for ever floored."

If you keep a note of your expenditure in a book, it will help you to keep debt outside the door. It will do more, it will help you to form a surplus fund for investment. The greatest difficulty about saving is getting a beginning made. In however small a way, whatever method you adopt, make a beginning. I am not here to advocate total abstinence, though I believe in the principle, and practise it; but I shall be falling short of my duty if I do not declare that the greatest foe to thrift in every form is intoxicating drink. The sum spent in drink is worse than lost. If instead of being taken to the public-house it was taken to the Savings Bank, the Friendly, or the Building Society, instead of the woeful results that too often flow from selfish indulgence, there would be comfort and satisfaction.

I think it is the bounden duty of wives of working men, and those who look forward to that happy state, to inform themselves of the various methods of thrift which exist—of what they cost, and what they give—that they may help their husbands by wise counsel in the choice of that form best suited to their circumstances. With these words, I now proceed to bring before you a few of the most frequently adopted

Methods of Saving in Small Sums.—Savings Banks.

One method that stands deservedly high in this country, and is daily being adopted by increasing numbers, is the Savings Bank. Both the Trustees' Savings Banks and the Post Office Savings Bank have proved great boons to the wage-earning population of this country. They are near at hand. You can open an account with the small sum of 1s., and, thanks to the facility introduced by the late Mr Fawcett, who proved himself a true friend to thrifty working men, even the 1s. can be saved in pennies by the use of the stamp deposit slips issued at all the Post Offices. Some people still prefer to place the few shillings they can save in a stocking, where it is ever in danger of being withdrawn, and where it yields no interest. In the Savings Bank it is well out of the way of petty temptations, it is quite safe, and interest is added at the end of each year at the rate of 6d. a pound. The small sum of 1s. a week deposited in a Savings Bank will in twenty years amount to over £66. In the Edinburgh Savings Bank there are 62,153 depositors, who own deposits amounting

to £1,531,182. The average amount belonging to each depositor is about £25. In the Glasgow Savings Bank there are 140,000 depositors, and their deposits amount to four and a half millions sterling. The Post Office Savings Banks now hold deposits amounting to £48,000,000. The Trustees' Savings Banks (which are the most popular in Scotland) have £47,200,000. These banks offer also facilities for investing small sums in Consols, and through them large numbers of small investors have become interested in Government Stock.

Building Societies.

In Sir Arthur Mitchell's interesting work, "The Past in the Present," there are a few statements in regard to the housing of the people, which cannot but lead one to the reflection that there is much to be done in this direction. He says that nearly a third of the population of Scotland live in houses of one room. In Edinburgh we have, in round numbers, 33 per cent. of the population living in houses of one room, and 30 per cent. in houses of two rooms. The corresponding figures for Glasgow are 41 per cent. in houses of one room, and 37 per cent. in houses of two rooms. These figures are in the face of the fact that an enormous improvement has been going on for thirty or forty years in house building. There are 7,000,000 dwelling-houses in this country, the average value of each house being £320—this sum being fully 50 per cent. higher than was the average value in 1860. This improvement is greatly owing to the operations of the building societies. Since 1861 one company in Edinburgh has provided 1000 houses and shops for the working classes and others at prices varying from £130 to £400. This company offers peculiar facilities to men to become their own landlords, and pay no rent. A man may purchase a house from it, and receive 95 per cent. of the price on loan, repayable by monthly instalments in a certain number of years. If fourteen years is selected, the monthly instalment to redeem a loan of £150 is £1, 5s. 3d. There are several excellent building societies in Edinburgh, both on the terminating and permanent principles, which offer an excellent method of saving to men who wish a good interest on sums saved by small periodical payments, as well

as aiding members who may wish an advance to build or purchase a dwelling-house. Societies on the terminating principle start new sections almost every year, and it frequently happens that a member finds himself, in return for a contribution of 1s. a fortnight, the happy possessor of £25 at the end of twelve and a half or thirteen years. This happy result is attained by the operation of compound interest, *e.g.*, a contribution of 10s. a month at 5 per cent. gives £6, 3s. 3d. in one year, £35, 2s. 9d. in five years, £50, 7s. 5d. in seven years, and £121, 16s. in fourteen years. I may quote as an illustration the fact that one Society* in Edinburgh, in return for 1s. a fortnight paid in during the last thirteen years, is about to return to a section of its members £25 per share, being £16, 18s., the cash paid in, and £8, 2s. of interest or profit.

When a borrower from one of these societies takes his loan, redeemable by instalments spread over twenty-one years, his payments to the society frequently do not exceed the rent which he formerly paid. This system of thrift has not taken root and spread in Scotland as it has in England. This may be due partly to the high fees charged by lawyers for conveyancing. In Scotland there are 50 incorporated building societies with assets of £1,000,000, and 153 unincorporated societies. In England there are 2044 societies, with a membership of above 600,000, and assets close on fifty millions sterling. In Lancashire and Yorkshire there are many thousands of cottage homes that have been built and acquired by operatives entirely through the facilities afforded them by building societies.

Friendly Societies.

Friendly societies are the outcome of a natural desire on the part of working men to protect themselves against the enemies of their lives,—or rather, what without such protection would be evil times in their lives,—such as sickness and the feebleness of old age, and to mitigate the blow which death deals when it visits the home. In this system we once more see the beneficent working of association. The general public who are well-to-do, and whose income is not affected by sickness, have little idea of all that the well-constituted Friendly Society means to those who earn weekly wages, and whose wages cease the moment they

* The Permanent Scottish Union Property Investment Building Society.

are laid aside by sickness. The growth and spread of this system of thrift has been enormous. The subject is so wide, of such great interest and such deep import, that not one lecture only, but a series of lectures, would be required to set the history, the working, and the results of these societies before you in a complete form.

A few years ago the ex-Premier, Mr Gladstone, said, "Friendly societies have become so important and telling a feature in the constitution of English Society in its broadest and most fundamental part, that any account of this nation, of this people to whom we rejoice to belong, would deserve no attention as a really comprehensive account if it excluded the element of such societies."

The good that these societies are effecting for the nation in a quiet and unobtrusive way is incalculable. By the amelioration they afford to the lot of hundreds of thousands of prudent working men they form the strongest barrier that could be raised against the impracticable proposals of ill-informed socialistic agitators. Far away at the head of all the many varieties of this form of association I would place these splendid institutions which are known under the name of the

Affiliated Orders.

It will not be possible to give an account of the whole of them, but I should like, while expressing my admiration of societies such as the Ancient Shepherds, the Rechabites, the Gardeners, and the Druids, to refer more particularly to the two great Orders that take the leading place among these organizations—viz., the Oddfellows (Manchester Unity), and the Ancient Order of Foresters.

The Oddfellows.—The Manchester Unity of the Independent Order of Oddfellows was formed about the year 1812. It would take too long to trace its history through the time of its early difficulties until the light of actuarial and medical knowledge enabled it to adjust the scale of contributions to the benefits given. In 1860 the Executive of the Unity wisely determined to obtain returns of sickness and mortality for the previous five years from the various branches. There had existed up till this time several defects in the construction of the tables of contributions, the chief of which was the error of making the contributions payable by

entrants at advanced ages no higher than those payable by the younger members.

The result of the investigation was to reveal that the great majority of the lodges were practically insolvent. The way in which the Order, by courageous self-denial, faced this state of matters and overcame its difficulties, is a triumphant page in its history. Since that date the progress of the Society in numbers and wealth has been upward and onward. The following figures are eloquent of the solid and satisfactory position which the Order now enjoys, and of the immense good which is every year being conferred on its membership. There are 4375 lodges, embracing 627,594 members. The funds proper of the Order were, at the end of last year, £6,297,643, being an average of £10, 2s. 11¼d. per member. These funds yielded interest at the rate of £3, 18s. 11¾d. per cent., or £231,747. The contributions from members amounted to £666,712, and the gross income of this one Society reached the enormous total of £905,666, 6s. The expenditure amounted to £666,636, of which £535,990 was expended in sick benefits, and £130,646 in funeral benefits. The sickness benefits generally are 10s. per week during the first twelve months, and 5s. per week thereafter. The funeral allowance on the death of a member is £10, and half that amount on the death of a member's wife. The contributions for these benefits are :—

At age 20,	1s. 6d. per month (lunar),	or 19s. 6d.	per annum.
„ 30,	1s. 11d. „	or 24s. 11d.	„
„ 40,	2s. 8d. „	or 34s. 8d.	„

The banner of Oddfellowship has been carried into many lands. In America the Baltimore Unity alone has now a membership of 534,235.

The following table, showing for various ages the average amount of sickness and mortality during a period of ten years, will be of interest to members of these societies :—

	Sickness.	Mortality per cent.
Age, 20 to 30, . .	8½ weeks.	7·4
„ 30 to 40, . .	10½ „	9·9
„ 40 to 50, . .	15½ „	14·8
„ 50 to 60, . .	27¾ „	25·3
„ 60 to 70, . .	64 „	48·7

The error in the original rates of the Order previously referred to is at once apparent, for if a man of fifty is on an average laid up three times as long as a man of twenty, he should pay a much higher contribution than the latter.

The Foresters.—The statistics of the Ancient Order of Foresters are almost as astonishing as those of the Oddfellows, and exhibit a state of progressive prosperity which must be most gratifying and comforting to every member of its widespread brotherhood. The figures in its annual reports reveal a state of matters most creditable to the administrative ability of those who manage its affairs. The funds, amounting to about £4,000,000, are securely invested. The whole business is managed with ability and economy, and the results to the membership, now numbering close on 700,000 men, are most satisfactory and valuable. The self-respect, independence, and education in thrift which a society of this kind gives, commend it to the regard and admiration of all who love their country and seek the welfare of their fellow-men. I am glad to find that there are now about 40,000 benefit members in Scotland of this Order, and that the number is increasing year by year.

The limit of benefit which these societies are capable of extending to their membership has not yet been reached; there is still an element of comfort which they are capable of bestowing to a greater extent without any great enlargement of the contribution. I refer to superannuation, or, as it is more frequently termed, old age pay. Many a man, if he understood the benefit of a deferred annuity, and for how small a single or annual payment it can be purchased, would be willing, by present self-denial, to make an effort to obtain it. The longevity of annuitants is proverbial.

The United Sisters.—A friendly society for women has lately been started in England by the Rev. J. F. Wilkinson, Rector of Kilvington, one of the best informed writers on the subject of friendly societies in this country, and the author of a most interesting book called "The Friendly Society Movement." The Society is called the "United Sisters' Friendly Society—Suffolk Unity;" and its object is to grant to working women for moderate monthly contributions, sickness and funeral benefits and pensions in old age. Professor Leone Levi estimated that there was a total of 4,020,000 women who earned their own living in this country,

and he estimated their annual income (exclusive of board and lodgings) at little short of £100,000,000. In view of facts like these, it is well that there should be an affiliated Order specially applicable to the circumstances of female workers and wage earners. If I might be allowed to suggest a subject for next winter's programme of lectures, it would be, "The best methods of thrift for working women;" and I think we have in our midst at least one lady who has the requisite knowledge and ability to make such a lecture both interesting and instructive.

Collecting Societies.

The next subject is one which I approach with hesitation. It relates to those societies erroneously classed as friendly, consisting of no end of variety—collecting, industrial, funeral, and so on,—but all existing with the one object, to make money out of the creditable desire of the unthrifty poor to avoid a pauper's funeral. The great extent of the business of these societies, however much to be regretted, cannot be denied. It goes on year after year in ever increasing volume, and in a manner meets a want. The pity is that the poor patrons of these concerns cannot get better value for their money, and that the spirit of thrift is not strong enough in them to enable them to rise to more profitable methods of attaining the object they have in view. Unsatisfactory though this provision be, we cannot but admire the feelings that give rise to the wish for it. It is natural that the wage-earner who has nothing saved should stand in dread lest when death visits his home it should find him unprepared to discharge those duties of decency and affection which the taking away of a loved one imposes. All well so far as it goes, but we cannot but deplore that working-men and their wives in such vast numbers are satisfied with this wretched apology for thrift. It may be urged that it is better than nothing—that it is a step in the right direction. It is a step—the goose step of thrift—with no progress or hope in it—having the appearance of movement without the reality. The great bulk of the business done by these societies consists of assurances on the lives of young children. A cry has been raised lately that this has led to increased infantile mortality, and Parliament is being called upon to put an end by statute to the system. I do not think that there

has been sufficient evidence to justify legislation on the ground alleged. There is, however, abundant reason why every effort should be made to educate workmen and their wives in regard to wiser and more profitable methods of investing the pence which they have to spare.

There is one company which has deservedly shot ahead of all others of its class in the extent of its business and the immensity of its accumulations. Last year the Prudential had in its industrial department a premium income of £3,658,501, and funds amounting to £5,409,827, while its policy-holders numbered 7,599,554, being more than one-fifth of the whole population of the country.

The collecting societies employ a perfect army of men, who go round each week to collect the pence at the members' homes, and this of course involves great expense. For the most part their clients represent the poor who are kept poor by self-indulgence and thriftlessness. It is earnestly to be desired that recruits from this class could be won over from the verge of pauperism to the ranks of the thrifty and well-to-do. One step in this direction will be attained when the legislature receives instructions from the people to enact a law decreasing or altogether suppressing the public-houses which are at present permitted to be so thickly planted in the midst of the homes of our industrial population.

Life Insurance.

I will now briefly refer to the subject of Life Insurance, a form of thrift which adapts itself to the circumstances of all classes. Edinburgh has attained a world-wide renown for the excellence of its life insurance institutions. It contains the head offices of thirteen life companies, which have a total income from premiums and interest considerably exceeding £5,000,000 per annum. The life funds of these offices amount to nearly £40,000,000. The sums dispensed each year by them in satisfaction of the claims of widows and orphans and others exceeds £3,000,000. These are large figures, but they would be much larger if the provisions granted through their aid were better known and understood.

The distinguishing advantage which attends a life policy as compared with other methods of saving, is that it creates, for a small

payment, a large provision immediately available if death takes place. It takes a long time for 35s. to accumulate to £100; but by paying 35s. yearly to a company, a man aged 25 can insure £100, payable to his heirs in the event of his death, even if death takes place the very day he gets his policy. The duty of insuring, to a man who surrounds himself with the blessings of wife and children, who without him would be left in want and poverty, is very clear. Indeed, I might go further and say that anyone with a family dependent upon him, and him alone, for maintenance, who neglects, wittingly or unwittingly, to make provision for them, deserves the unqualified condemnation of his fellow-men.

An objection, frequently urged against life insurance, is, that the person who insures cannot obtain any benefit from it himself; but this is a mistaken idea. One form of insurance which is becoming increasingly popular is called the endowment assurance plan. As an example of its working, I may state that a man of 30 can insure for £100, which will be paid to himself when he attains age sixty, or to his family if he should die previously, by paying a yearly premium of about £2, 7s. It is difficult to over-estimate the benefits of an insurance of this kind. It gives a man the feeling of independence, as he knows that in the event of his dying at an early age, he will leave his family provided for, and if, on the other hand, he should live to a good age, his later years will be free from all anxiety about money matters.

Canon Blackley's National Insurance Scheme.

The well meant and untiring assiduity of Canon Blackley in advocating a national scheme of insurance (now happily shelved), was of considerable value in calling public attention to weak points in the Friendly Society system, and to the enormous expense at which the industrial companies conducted their business. "I propose," says Mr Blackley, "that every individual in the nation shall be liable by law, after reaching the age of eighteen years, to contribute, either in one sum or by instalments, £10 to a National Sick and Pension Benefit Society, which would secure to him or her, when prevented by sickness from earning his or her usual wages, a sum of 8s. a week until seventy years of age, and after seventy years of age a cessation of the sick pay, but a

pension for life of 4s. a week." The Select Committee which sat upon the scheme dismissed it as impracticable. It was found to be actuarially unsound; and besides, it met with the strenuous opposition of the working classes, who, knowing what is being accomplished by voluntary effort, object to any further extension of that inquisitorial interference on the part of the State, which is, in this direction, as mischievous as it is unnecessary.

Concluding Remarks.

I have to-night endeavoured to bring before you something of what has been accomplished by combination in benefiting the condition of the working-classes; I have also pointed out how their lot has been further ameliorated by the principle of co-operation; and, finally, I have referred in detail to several of the methods which in this country are most popular among the thrifty, and which have already proved successful in adding to the well-being of the masses of the people. I fear that in doing so I may have indulged in the use of statistics to an extent that must have been somewhat wearisome; but these dry figures become suffused with a deep interest when we remember the splendid and self-denying principles to which they relate. The knowledge of wise methods of thrift should be widely spread among the people; for many a man learning of these helpful associations and brotherhoods which I have brought under your notice has, by entering into them, been delivered from the depths of hopelessness and selfishness, and been raised to a new life of hope and service.

And now, may I be permitted in closing, to express the hope that none of us will allow ourselves to be so absorbed in the pursuit or possession of worldly good as to neglect the attainment of those riches and that home which are of inestimably more value, because they endure for evermore, and which a loving Father has offered free to all through the glorious brotherhood of the man Christ Jesus.

"It's no worth the warsle for't
A' ye'll get on earth,
Gin ye haena wealth aboon
Mair than warl's worth.

ANIMAL HEAT: HOW IT IS PRODUCED, LOST, AND PRESERVED.

By R. MILNE MURRAY, M.A., M.B., F.R.C.P.E.

I HAVE here before me two rabbits—the one, as you can all see, obviously alive, active, capable of movement. When I touch it, it shrinks; when I gently pinch its ear, it pulls it away. Further, if I place my hand on its body, I am conscious of a sensation of agreeable warmth—its body is as warm, or warmer, than my hand. From these two observations—namely, the creature's power of movement and the warmth of its body—we conclude that the rabbit is alive. If, now, I turn to the other rabbit, I find a different state of things. I touch it, it does not move; I pinch it, it does not shrink. Moreover, if I place my hand on its body, I am conscious of a distinct sensation of cold—its body is colder than my hand. From these two observations — namely, the absence of the power of movement and the absence of warmth— we do not hesitate to conclude that the animal is dead. Here, then, we have established, so far as these observations go, two very definite relationships, namely :—

With *life* we have—

1. The capacity for MOVEMENT.
2. The presence of HEAT.

With *death* we have—

1. The absence of capacity for MOVEMENT.
2. The absence of HEAT.

Are we, then, to make these observations general, and say that every living animal must possess these two qualities :—

1. A power of movement.
2. A power of imparting a sensation of warmth to other animals ?

Before deciding this point, let us extend our experiments. Here, as you see, is a specimen of a very interesting animal—a frog. Now, when I touch it, you can have no doubt as to whether it is alive or not. Its power of movement is obvious and vigorous. So far, so good. But when I touch it, do I feel any sensation of warmth? No. On the contrary, I am conscious of a distinct sensation of disagreeable coldness—a sensation more marked and much more unpleasant than in the case of the dead rabbit. Are we, then, to conclude that there are some animals whose vitality is evidenced by movement and heat, and others, such as the frog, whose only evidence of vitality is movement? Perhaps we shall arrive at a correct answer if we consider a simple experiment. I have here a piece of ordinary sculptor's clay, a substance which is undoubtedly destitute of life. If I place one piece of this in water at boiling point, and another piece in water at the temperature of melting ice, and insert in each a thermometer, I shall find in the course of a minute or two that the clay will in both cases assume the same temperature as the water in which it lies. In the one case it will be warmed up to boiling point, and in the other it will be cooled down to freezing point.

I have here a table showing the result of an experiment which consisted in placing a frog in water of different temperatures, beginning with ordinary, and proceeding to colder ones, and at the same time carefully noting the temperature of the animal in the successive conditions.

Temperature of Water.	Temperature of Frog.
41·0	38 0
30·0	29·6
20·6	20·7
5·9	8·0
2·8	5·3

Now you will notice that in the first experiment the water stood at 41°, while the frog showed 38°, that is, the frog is colder than the water. In the second the water was 30°, the frog 29·6°, still a little colder. But at the third the water was 20·6°, while the frog was 20·7°—the frog being a little warmer than the water; and in the last two the frog was 2·1° and 2·5°

respectively warmer than the water. Now it is perfectly obvious that were the frog constituted like a lump of clay, such a state of matters would be impossible. It is perfectly plain that a living frog is really producing a certain amount of heat, otherwise it could not have continued so much warmer than the water in which it was immersed. Unlikely as it may seem at first sight, it is nevertheless true, that the production of heat in the cold, disagreeable, clammy frog is as much an essential condition of its vitality as it is of that of the rabbit. We may then make the general deduction that MOVEMENT and HEAT are essential manifestations of living animals. Every living animal is capable of moving, and every living animal is producing heat. So far as our ordinary experience goes, the faculty of movement needs no demonstration. You say an animal is alive because you see it move. That heat-production is also an essential property of living animals is perhaps scarcely so obvious, but it admits of easy proof. In these cold nights when you undress and go to bed, provided you have neither a fire in your bedroom nor a warming-pan, the first sensation on going between the sheets is that of coldness or chilliness. This unpleasant feeling soon passes off, you fall asleep, and on awaking in the morning, though the air of the room is chill and cold, your whole body and the bed-clothes are warm—beautifully warm. Where has the warmth come from? From your body, undoubtedly. You have warmed the bed-clothes. They, like other clothes, are there, not to keep the cold out, but to keep the heat in. There can be no doubt of this. If you put a marble statue to bed under like conditions, the statue and the bed-clothes would be as cold in the morning as they were at night.

Let us then proceed to inquire how this animal heat is produced by living beings. A simple experiment will enable us to feel our way to an answer. I have here a model of a steam-engine. I place in the boiler a little water, and in this lamp, which acts as the furnace, I have placed some spirits of wine. I light the lamp, and I immediately perceive that heat is given off by the lamp, and in course of time the boiler will become warm. In a little while the water will be converted into steam, and the fly-wheel will be driven round by the movement of the piston. Here, then, we have a very good working model, not only of a

steam-engine, but also of a living animal, for we have here MOVEMENT and HEAT. But, further, if I blow out the lamp, what happens? The engine stops, movement ceases, and if I wait a little the machine will become quite cold. Here I have an excellent illustration of death in an animal. The blowing out of the lamp is the extinction of life; the cessation of the movement and the disappearance of the heat are the indications of this death. The purpose of a steam-engine is to move and to produce movement in other machines. But a cold steam-engine cannot move, it must first be heated; remove the heat, and the movement ceases. Now to all intents and purposes this is exactly the state of matters with a living animal. A certain amount of heat is an essential condition of movement; remove that heat, and the possibility of movement ceases. The animal becomes a dead thing. Such a machine as this little steam-engine may then be regarded as a working model of the animal body. No doubt the animal is a much more complex mechanism, but for practical purposes, and so far as the heat and movement-producing processes are concerned, we may regard the one as a type of the other.

Let us then first ask, what is the source of the heat in the engine? That is obviously the spirits of wine in the lamp, and, in the case of a real engine, the coal in the furnace. But neither spirits of wine nor coal can produce heat in the engine by remaining spirits of wine or coal. To produce heat they must undergo a chemical change—in popular language, they must be burned. Now, what is this chemical change, this burning? Here is a spirit-lamp. I light the wick, it burns and gives off heat. I put a glass cap over the flame; it ceases to burn. Why? Because I have by this means cut off from it a supply of a certain other substance—namely, the oxygen of the atmosphere, the presence of which is essential to the combustion of the spirit. This simple experiment shows that two things are necessary to the production of heat by this means:—

1. A substance capable of being burned;
2. A substance which enables it to burn,

or, more accurately, a combustible body and a supporter of combustion. The combustible body is here the spirits of wine. The supporter of combustion is the oxygen of the atmosphere. Many of you have frequently performed an experiment which illustrates

this scientific fact in a very striking fashion. When a newly lit fire shows signs of going out or dying, the best prescription for its restoration is the administration of an extra dose of air or oxygen by means of a pair of bellows. In blowing up a fire we simply pump in an extra supply of air—the supporter of combustion, to the combustible body—the coal in the grate. In this way you hasten the chemical process, cause the fire to burn briskly, and so increase the quantity of heat produced. But atmospheric air does not consist of pure oxygen. The oxygen is mixed with a large proportion of another and totally inert gas, called nitrogen. Were it not so, chemical processes on which our life and comfort depend would take place with tremendous energy, incompatible with convenience, or even with life. The nitrogen is present as a diluent. It dilutes the oxygen, moderates and delays the processes, but in no sense alters their nature. Now, in order to impress upon you the enormous importance of this oxygen in heat-producing chemical change, I wish to show you some experiments. Here is a jar of pure oxygen gas, not mixed with any nitrogen. I have here a little sulphur, which on being lit burns with a sputtering blue flame. I plunge this into the jar of oxygen, and you see it blaze out with a brilliant flame, giving off abundance of light and heat. Here, again, I have a piece of charcoal. I place it for a little in the flame of the lamp, and when I withdraw it, it is glowing with a red spark. But when I place it in the jar of pure oxygen it bursts into a flame of dazzling brilliancy. Once more, here is a bundle of iron wire, the end of which has been dipped in melted sulphur. I ignite the sulphur, and then direct a stream of oxygen on the bundle, and you will notice that after the sulphur has been burned away the wire catches fire, and the heat produced by the burning melts part of the rest of the wire, and it falls in drops into the plate below. These experiments clearly illustrate the importance of oxygen in the process of burning and in the production of heat. Now, you will remember that we agreed that a cold engine cannot move; that in order to move it must be warmed, and that this warmth or heat is obtained by the combustion of spirits of wine or coal; and further, I have shown that the presence of oxygen is an essential condition of this combustion.

But further, and this is the point, a cold animal cannot move; a cold animal is dead. Heat is as essential a condition of a living animal as it is of a moving engine. Whence, then, comes the heat?

Now I shall try to show you that the heat of an animal is produced by the combustion of a fuel, and that oxygen supports this combustion in a manner quite similar to what occurs in the engine. The fuel of the animal we term Food.

Here, then, is a striking resemblance between an animal and an engine. But before discussing this more minutely, I must point out to you an important difference between an animal and an engine. In a lecture delivered before this Society last year, on the subject of "Tear and Wear," Professor Stirling showed you that the body in doing its work is continually undergoing a process of loss. We cannot think, speak, or move without a certain amount of tear and wear occurring at the same time. Accordingly, it is essential that this loss be continually made up to the living animal, as the particles forming the muscles, nerves, bones, &c., are being used up by the performance of the animal functions, new particles must be added to take their place. Some of the particles constituting the body now may be gone in an hour, and unless the body is to waste they must be replaced by others. Now this is a very different state of matters from what holds in the steam-engine. No doubt there is a certain amount of tear and wear in the machinery of the engine, but, compared with the work it does, that is comparatively small. Thus, after ten years' work, the same particles of iron, brass, and wood which went to make the engine at the beginning of its existence, are there still. But I am probably correct in saying that in the case of none of you here will a single particle which enters into the composition of your bodies now, be present in them ten years hence, that is to say if you continue living animals all that time. Every thought you think, every word you utter, and every movement you perform, results in the organic dissolution of brain or muscle or bone; and unless this dissolution were made good by the addition of new material, it would soon be impossible for you to think or speak or move. This, then, is the striking difference between an animal and a machine, a difference which must not be lost sight of. The fuel which an engine consumes is entirely expended in

producing heat and movement directly; none of it goes to renew the wear of piston, valves, and wheels. If a crank shaft gets broken you cannot mend it by putting a particular kind or an extra supply of coal into the furnace, it must be taken to the shop and repaired. But not so with the animal. The food which he eats not only goes to produce heat and movement, but some of it goes likewise to make up for the wear and tear of the working parts. The loss of brain weight in thinking, and muscle weight in moving, are made good from the food we are eating. If a bone breaks we do not unship it and send it off to a surgeon to be spliced or rivetted; the surgeon comes, sees that the ends are properly placed, and taking care that suitable food is given, leaves the rest to the patient.

Now, with this distinction between the animal and machine before us, let us see in what way the food we eat becomes the fuel which produces our heat. We shall find that the process is ultimately identical with what occurs in the engine, though the details are vastly more complex. When food is taken into the body, before it can be of use to the body it must first be digested. By means of digestion, which is an extremely complex process, the food-stuffs, such as meat, sugar, starch, fat, and so on, are altered in their chemical and physical properties, and are ultimately conveyed into the blood. These changes occur in the stomach and intestines, and the digested food is taken either directly into the blood-vessels which circulate in the walls of these organs, or indirectly through an intermediate set of vessels termed the *lacteals*. In any case the important thing to keep in mind is that all the useful material taken into the body as food ultimately reaches the blood. The blood which circulates in all parts of the body, then carries to every tissue, brain, muscle, bone, &c., the various materials which it has derived from the digestion of the food, and, in some way, of the nature of which we know nothing, these tissues select from the complex constituents of the blood that particular kind of material which is necessary to repair them, and to enable them to perform their work. By the constant presence of the nutrient blood, the wear and tear of the tissue in working is continually made up. No sooner does a muscle or a brain cell lose some of its particles in contracting or thinking, than it immediately makes good that loss by taking from the blood which

bathes them, just that kind of material which will make good that loss. In this way every tissue in the body provides itself with its own appropriate food, or as we shall see, with its own fuel. For the material so brought to the muscle is capable of being burned, just as truly and completely burned as the coal in the furnace of the engine. But it cannot burn, and so cannot give rise to heat and work unless it is provided with a suitable supply of oxygen. Where does the oxygen come from? You are all aware that sixteen or seventeen times per minute you are filling your lungs with air from the surrounding atmosphere, which as you know contains a large quantity of oxygen. The air passing through the windpipe enters tubes termed bronchi, and these end in innumerable small vesicles of exquisite thinness, on the outside of which a close network of small blood-vessels is arranged. Now these blood-vessels are carrying a steady stream of blood from and to the heart, and the blood coming from the heart, while it gives off certain things which escape through the lungs into the atmosphere, takes back to the heart from the lungs a very large quantity of oxygen. This oxygen then is carried by the blood to every tissue in the body. Thus is provided the oxygen necessary for the process of combustion, which takes place in the tissues, and which enables these tissues to produce heat and do work. The blood, therefore, brings not only fuel to the muscle-engine, but also the oxygen to enable that fuel to burn. Shortly stated, the case stands thus: Through the mouth food of various kinds enter the digestive canal, and there, by complex chemical processes, it is gradually altered until certain portions of it are ready to enter the blood, the rest being rejected as waste material. The food so altered passes into the blood, which is now charged with nutriment for the tissues. These tissues seize upon the particles so brought to them, and so make good their wear and tear, and at the same time they lay in a store of fuel which will provide for heat and work. But the same blood containing and carrying this nutritive material is steadily flowing through the lungs, and bringing from the lungs a supply of oxygen, which, likewise seized by the tissues, enters under certain conditions into chemical union with the food which they have taken up, and this chemical union is the source of the heat and work of the body.

It will now be apparent to you how striking is the difference

between the steam-engine and the animal body in their modes of working. In the engine all the fuel is burned at one part of the machine—the furnace. The heat given out warms the water, converting it into steam, the steam presses on the piston, and the machine moves, but in the animal every organ in the body takes its own supply of fuel. There is no one place where the heat is produced. Every organ is warm, not merely from heat got from a neighbouring organ, but from the heat which it produces in itself. Every muscle has in itself its fuel and furnace, its piston and cylinder, and the chemical process of combustion, or, to speak more scientifically, oxidation takes place in itself. The fuel, the oxygen, and the moving parts are all contained in the muscle itself. The animal body may then be described as being composed of a multitude of machines, each taking in its own fuel and oxygen, and each giving out its own heat and work. I may illustrate this by an experiment. Here is a muscle taken from a frog. The frog has been dead—*i.e.*, dead to all feeling and power of voluntary movement for some time. But in the case of cold-blooded animals like the frog, the death of individual tissues, such as the muscles, takes place slowly. Now, before the death of the frog, the muscle which I have here had laid in a store of fuel and of oxygen, and in order to enable this muscle to move, all that was necessary was to light the fire, as it were—in other words, to cause the oxygen and fuel to burn. Now, in the uninjured animal this is brought about by the nervous impulses sent from the brain and spinal cord. These reach the muscle by the nerve, and on arriving at it, they cause some of the fuel to combine with the oxygen, and so give rise to work and heat. Now, in the dead animal we can cause this combustion to occur by employing currents of electricity to excite the union of the oxygen and fuel. I fix the muscle in a clamp, and attach its lower end to a lever. The index of the lever has attached to it a piece of white paper to enable you to see its movements. The nerve in connection with this muscle is laid upon two wires which come from this piece of apparatus, from which weak electric shocks are sent. The rate of these shocks is regulated by this spring. Now, when a shock is sent to the nerve, the electric current causes the oxygen and fuel of the muscle to unite, and this union is shown by the shortening of the muscle. As it

shortens it raises the lever, and so does work. And now you can see, when I start the spring, that at each beat of the latter the muscle shortens and the lever is lifted. When the current ceases, the muscle relaxes, only to contract when the next current reaches it. But let me carry the experiment a little further. This muscle having been cut out of the body, is away from the blood and oxygen supply. Hence it is obvious that if I prolong the experiment, I shall, sooner or later, use up all the food and oxygen, whereupon the muscle will cease to contract or give out work. This is exactly what happens, as you see. You will notice that if I continue the application of the stimuli to the nerve the contractions get fainter and fainter, and ultimately cease. The muscle has used up its stock of fuel and oxygen, and it can no longer produce work enough to lift the lever. Now, if this muscle were attached to the body, and had bloodvessels containing nutrient blood coursing through it, it would soon lay in another stock of fuel and be ready again for work in a short time. But this muscle, while it has been producing work, has also been producing heat. I must ask you to take my statement for it so far, because though it is quite possible to demonstrate the fact that heat is given out even by so small a piece of tissue as this, the demonstration involves the use of complex apparatus, and would have occupied too much of your time. But that muscular work is accompanied by the production of heat can be demonstrated otherwise very readily. Thus, if a suitable thermometer be plunged into the muscles of the thigh of a dog when these are in active contraction, the heat causes the mercury to rise several degrees. And again, we are all familiar with the influence of muscular exercise in our own bodies on the production of heat. You have only to recollect the effects of a sharp game at tennis, football, or cricket, or even a smart run or walk to catch a train or car. In running you set whole masses of muscles in active contraction, and these while producing motion are also producing heat. The result is, that when your efforts are over and even before it, you are conscious of a very definite sensation of warmth. If you doubt this now, recall what I have said next time you have to hurry half a mile to the Waverley Station with a heavy portmanteau in one hand and a brown paper parcel in the other.

The muscles, then, are the great heat-producing tissues in the body, just as they are the great work producers. It has been estimated that about four-fifths of the entire heat in the body is produced in the muscles. But though these are the most important heat-producing tissues they are not the only ones. For wherever chemical change is going on, wherever oxidation is occurring, there heat is being produced. Thus, in the whole length of the digestive canal, while food is undergoing digestion heat is being produced. Then the liver and other gland structures are important sources of heat. The processes connected with the function of the liver are various and complex, and that a large amount of heat is produced there is shown by the fact that the blood leaving the liver is the hottest in the body. Then, again, a very large amount of heat is produced in the brain. You cannot think a thought or will to do an action without producing heat, and thus the blood leaving the brain is warmer than that going to it. And so we see that production of heat is an essential phenomenon of life. A living animal, whether active or in a state of comparative rest, is producing heat—the more active, the more heat, but never so inactive as to cease producing heat so long as it is alive. But some one may ask me, "Are we to believe that the various food-stuffs which we consume—the beef, potatoes, rice, sugar, fat, and so on, are burned up in our tissues—our muscles and brain, in the same way as the piece of carbon in the jar of oxygen." The answer to this question is "Yes." True there is a difference in the manner and rate of burning, but there is none in the results or products. The chemical substances which go to form most of our foods are—

Carbon.	Hydrogen.
Nitrogen.	Oxygen.

Let us take sugar for example. Here I have a table showing the percentage composition of ordinary cane sugar. You see it contains a large quantity of carbon. 100 parts of cane sugar contain

42·2	parts of	Carbon.
6·4	„	Hydrogen.
51·4	„	Oxygen.

That it contains this substance I can prove by adding to this

solution of sugar a quantity of oil of vitriol, which has the property of taking away from the sugar the hydrogen and oxygen and setting free the carbon. You see now the frothy mass of the charcoal or carbon which has been produced by this means. And now, to show you that the carbon of sugar can be burned and give off heat, I shall show you another experiment. Here is a tray containing some powdered sugar mixed with a substance called chlorate of potash. This substance contains a large quantity of oxygen stored up in it. If I now touch this mixture with a glass rod dipped in oil of vitriol the latter will set free a little of the oxygen, which will combine with the sugar, and in doing so produce an effect which will be obvious to you all. Now, if this quantity of sugar had been eaten by me, and used up in my tissues, it would have given rise to as much heat as if I had burned it in a quantity of pure oxygen. True, the combustion would not have taken place either so quickly nor with so brilliant an effect. That, though interesting to you, would have been distinctly unpleasant for me. But slow or fast the change is identical whether occurring in the body or out of it, and for a given quantity of sugar the heat produced is the same in either case. In the one case the heat is produced quickly and spent quickly, in the other it is produced slowly and spent slowly.

But further, when carbon, or a substance like sugar containing carbon, combines with oxygen, it forms a new substance—a gas called carbonic acid gas. This, like oxygen, is colourless and invisible, but its presence can be recognised by means of a delicate test. If the gas be brought into contact with lime water, the latter becomes milky from the formation of chalk; for chalk is a combination of lime and carbonic acid. Now, here is the vessel in which we burned the carbon and the oxygen. If I pour a little lime water into it you see it at once becomes milky—the carbonic acid seizes on the lime and forms chalk. But now, if I breathe through a solution of lime water, the same change occurs. Chalk again is formed. Why? Because my muscles and brain are constantly producing carbonic acid by the combustion of the food stuffs in them. Thus carbonic acid is being swept out of the tissues by the blood. When the latter reaches the lungs in search of oxygen it gives up in exchange for the oxygen the waste carbonic acid gas. While we breathe in oxygen we breathe out

carbonic acid, and hence the chalk when I breathe into lime water.

The heat thus produced in the human body is very great. It is difficult to convey an accurate impression of how much it amounts to. But perhaps you will get some conception of it if I tell you that the amount of heat produced by a man of average weight during a day of average work would be sufficient to raise about 63 lbs. of water from the freezing to the boiling point. Now, 63 lbs. of water is equal to about $6\frac{1}{4}$ gallons, so you can understand that the amount is not an insignificant quantity.

And this now brings us to the second point of my lecture. "*How is heat lost?*"

It is quite plain that if the human body were always producing and never losing heat, it must soon become so hot as to render life impossible. Thus if no heat were lost, in thirty-six hours the whole of the body would reach the temperature of boiling point—a condition by no means desirable. There must be some means by which this very large amount of heat produced in the body is lost or given up. The chief ways by which the body loses heat are four in number.

1. *Radiation.*—If a red-hot cannon ball were placed in the middle of this hall, and the hand held a few feet from it, a distinct sensation of warmth would be felt; showing that heat is being given off by the ball. The ball would all the time be growing cooler, and soon would cease to glow. In this manner the human body gives up much of its heat. The heat passes into the surrounding objects by the process of radiation, and the body becomes cooler thereby.

2. *Conduction.*—If I place a poker on the fire, not only does the part in contact with the burning coal become hot, but by-and-by the other end of the poker becomes warm. The heat is conducted along the particles forming the poker. The heat thus transmitted is lost to the fire, which is so much the colder. Now the human body acts in the same way in warming anything in contact with it. Thus much heat is given up to the clothes. When we remove our clothes at night, we feel that they are quite warm. When we leave our bed in the morning, we leave a large amount of heat behind us in the bedclothes. If you place your hand on a slab of stone you are conscious of a sensation of cold,

because you are giving up some of your heat to it. You take hold of a cold shovel or broom-handle, it is warm when you lay it down. You have warmed it by giving up some of your heat to it. In short, whatever you handle, if it is originally colder than your body, takes from the body a certain amount of heat, which is thereby lost to you. Much of the heat we produce must thus be lost in the prosecution of our daily occupations.

3. *Warming Expired Air.*—However cold the air may be which we take into the lungs, even where the atmosphere is at a temperature far below freezing-point, we are always conscious of a sensation of warmth if we breathe upon our hands. This simply means that we are warming, in other words losing heat to, the air. The amount of heat lost by this means is very great indeed, especially in dry, cold weather. For every chestful of air we expel, no matter how cold it was when it entered the lungs, leaves the lungs almost at the temperature of the body.

4. *Production and Dissipation of the Sweat.*—This mode of heat-loss is one of the most interesting and important processes in the body. To understand this process I must ask you to glance at some points in the structure of the skin. The whole body, as you are aware, is invested by this structure. If we examine a section of the skin we find that it consists of two layers —a superficial layer termed the epidermis or cuticle, and a deeper layer, the cutis or true skin. Now if we examine the cuticle with a sufficient magnifying power, we shall find it pierced in all places by numerous openings. These are the mouths of certain glands—the sweat glands, embedded in the true skin. They are coils of a minute tube leading up to the surface of the skin. But further the true skin contains a network of blood-vessels of exquisite fineness and closeness. It is scarcely possible to realise the extraordinary extent of this network of vessels, but it may help you to form some conception of it when you remember that you cannot prick the skin with a needle-point, however fine, without piercing one or more of them and so drawing blood. Everywhere, then, in the true skin do these minute bloodvessels ramify, but especially are they abundant round the coiled tubes of the sweat glands. Now, the function of the sweat gland is to produce and pour out on the surface of the skin that fluid which is familiar to us under the name of perspiration or sweat.

Nearly always in health the skin is more or less moist with this fluid, sometimes the quantity is so small as to be scarcely perceptible. Sometimes the skin is wet and soaking with it. How is this brought about? Let me try to explain it. These blood-vessels which I have mentioned do not always contain the same quantity of blood. On the contrary the quantity undergoes enormous variations. The larger of these bloodvessels are provided with a coat which has the same property as the muscle of the frog which I have shown you, namely, of contracting and relaxing. One of the layers forming the blood-tube is really a muscular coat, and when the muscle contracts the bore of the tube is narrowed, when it relaxes the bore is widened. Consequently, when the bore of the tube is narrowed a smaller quantity, and when it is widened, a larger quantity of blood will pass through it in a given time. Now these muscular tubes are under the influence of a particular set of nerves. These nerves are not like the nerves running to the muscles of the limbs under the control of the will. Thus we cannot narrow or widen our bloodvessels at our pleasure. These nerves are connected to certain parts of the central nervous system, termed the *vasomotor* centres, and these centres are affected by the varying conditions of the individual from time to time. Accordingly, if any of these vasomotor centres are excited to act, the nerves running to the corresponding blood-vessels carry an impulse to the muscular coat which will cause this coat to contract. The blood-vessel will be narrowed, and less blood will pass through the part of the body supplied. Conversely, if any circumstance or condition interferes with the activity of these centres, the impulses passing from them will be checked. The muscles will relax, the blood-vessels will be widened, and an increased quantity of blood will pass to the part. Now it is on the working of this beautiful mechanism that the rate of loss of heat largely depends. Let me illustrate this. Suppose an individual performs some active exercise, such as rapid running for some distance, his muscles, in order to produce the necessary movement, "burn up" a large amount of the nutritive material stored up in them, and consume a corresponding amount of oxygen. But this, while producing movement, also produces heat. The blood leaving the muscles gets warm, and this hot blood coursing through the vasomotor centres controlling

the blood-vessels in the skin causes them to diminish their activity, and accordingly the walls of the blood-vessels relax, and a very large amount of the hot blood passes into the skin. But in passing through these superficial blood-vessels, much heat is lost by radiation and conduction, and the blood then cooled passes into the general circulation. The clothes get warmer, and the surrounding objects get warmer, but the individual himself gets cooler. You have only to think of the appearance of a stout man, who, after having run half a mile to catch a train, drops into a seat just as the train moves off. He does not look pale by any means. He pants and puffs, and is very red in the face. Why? Because the heat produced by his muscles has warmed his blood. The warm blood has checked the action of the vasomotor nerves. The blood-vessels of the skin have dilated, and the redness of his face is a sample of the condition of the skin of his whole body. By and by the blood loses sufficient heat, it cools down, the vasomotor centres begin to contract the blood-vessels, and his face gradually assumes its natural colour. The same process occurs, moreover, whether the heat comes from inside or outside the body. Recall a crowded evening party—the rooms are hot and stuffy, the bodies of the guests soon become too warm, the blood again acting on the vasomotor centres, causes dilatation of the blood-vessels, and the people get red in the face, and very uncomfortable. The ladies create currents of air with their fans in order to carry away as much heat as possible. The gentlemen crowd near a door or window for the same purpose. But this is not all. No sooner do the skin-vessels become flushed with blood than the sweat glands begin to act. They secrete from the blood surrounding them a quantity of sweat, which they pour out on the surface of the skin. The skin is bathed in perspiration. And now the sweat so formed begins to evaporate, and in passing into a state of vapour it takes with it a portion—a very large portion—of the heat of the body. This depends upon a well known physical law that when a liquid is converted into vapour, heat is used up in this conversion. Thus when the sweat passes off in the form of vapour, it takes with it, as it were, a large part of the heat of the body. This loss of heat with the evaporation of fluid can be readily demonstrated by allowing a drop of any liquid which evaporates rapidly to fall on

the skin of the hand. For example, a drop of sulphuric ether evaporating from the skin produces a sensation of marked coldness—rapidly evaporating it takes away the heat with great rapidity, and hence the effect. Use is made of this fact in several ways. In surgery, for example, we sometimes, in opening a boil or abscess, first direct a spray of ether on the diseased part, which removes so much heat that it cools the nerves to such an extent as temporarily to suspend their function, so that the knife may be plunged in with little or no pain.

I trust it is now clear to you that the flushing of the skin under the influence of heat, whether it comes from an internal or external source, results in the loss of heat in two ways.

1. The large quantity of blood thus brought to the surface loses heat directly by radiation and conduction.
2. The sweat thrown out, in evaporating, carries away with it a certain amount of heat.

This now leads me to consider a very important matter in this connection—what physiologists term *heat-balance*. This is a term used to express the remarkable fact that in all warm-blooded animals the amount of heat produced above a certain point is invariably balanced by a corresponding amount of loss. Thus it comes that in a healthy animal the temperature of the body as a whole remains absolutely constant. For whenever the amount of oxidation in the body increases, so that heat tends to accumulate, the vasomotor mechanism comes into play, and as much heat is lost by skin-cooling and sweat-evaporation as will bring the temperature back to the normal. Thus we can perform violent physical exercise, or enter a very hot room, and our bodies do not increase in temperature by any appreciable amount. Those of you who have taken a Turkish bath will understand this. You enter the warm chamber, the air is many degrees warmer than your body, but your body does not rise to the temperature of the room. If it did you would certainly expire in a very few minutes. On the contrary, no sooner have you lain down than your skin assumes a pink or red colour, and is by and by bathed in a profuse perspiration, and the evaporation of the sweat in the dry air of the room carries away the heat which, if it entered the body, would produce fatal mischief. In health the temperature of the body never rises above 100° F. in its deeper parts,

and 98° F. in its superficial parts. The capacity of this heat-regulating function is very great. Experiment has shown that a person may remain for a considerable time in a dry atmosphere at a temperature much above that of boiling water simply in virtue of the process I have described. On the contrary, when the atmosphere is moist, he is placed at a considerable disadvantage, because then the sweat cannot evaporate, and hence the limit of temperature endurable in a moist atmosphere is much less than in a dry one. This, of course, further explains why and how we perspire so readily in warm summer weather, and do so with much less readiness in cold weather. Further, it accounts for the well-known fact that we can exert ourselves so much less comfortably in muggy warm weather when the air is damp than on a bright day with a dry atmosphere. In the one case the clammy sweat remains on the skin, keeping in the heat; in the other, it passes off as vapour, keeping our temperature cool and comfortable. But, now, what will happen if we are placed in cold surroundings, say in cold frosty air, much colder than our bodies. How do we retain our heat, then? The cold air has an effect opposite to that of the hot air. Cold causes the blood-vessels of the skin to contract, the tubes become narrow, the skin becomes bloodless, and the heat is preserved by the blood being imprisoned in the vessels of the deep parts of the body, away from the cooling effects of the cold surroundings. Thus, while the surface of the exposed parts of the body may on a cold day feel cold and be really cold, still, in the keenest frost, a thermometer placed in the mouth will still mark 100° F. It is then the special characteristic of warm-blooded animals that their temperature remains practically always the same. All the heat produced above a certain maximum is given off by a special mechanism, and thus the "heat-balance" is maintained. In cold-blooded animals, on the contrary, the condition is different. Animals like frogs have a far less constant temperature, and they are largely at the mercy of their surroundings. A frog in a Turkish bath would be a very unhappy frog indeed. For in a very short space of time his temperature would rise until it reached the temperature of the room. Only before the realisation of this untoward event, the poor animal would have ceased to exist.

I must now say a word about what we term FEVER. Fever is

a result of a diseased condition which interferes with the heat-balance. More heat is produced than is got rid of. This may be brought about in either or both of two ways. First, more than the normal heat may be produced in the tissues by the increased oxidation, or second, the heat-losing mechanism fails to act. Usually both factors play a part. Those of you who have seen a case of fever will recollect the hot dry skin. It may be red or not, but in any case it is hot and dry. The sweat-glands are inactive, and thus, while the heat-producing mechanism is active, over active, the heat-losing mechanism is disorganised. Moreover, the evil tends to increase itself, for the hot blood stimulates the heart to more rapid action, causes it to drive the blood more rapidly through the lungs and body generally, and thus promotes oxidation and heat-production, and this is the great danger in fever. For the heart becomes fatigued, and may ultimately cease to act from sheer exhaustion. Generally one of the first signs of the abatement of the mischief and commencing recovery is the moistening of the skin by the sweat, which is usually soon followed by slowing of the heart.

I have left myself a very short time to say anything about the third part of my subject—*How to preserve and regulate the heat of the body.* The risks run by an individual in whom the heat-producing or heat-losing mechanism is disordered are very great, and they predispose to many diseases, the onset of which is popularly described as "getting over-heated," "catching a chill," &c. I must confine myself to referring to a few points of practical importance bearing upon this question.

1. The first essential is its regular and sufficient production. This depends primarily on the consumption of a *proper amount of suitable food.* If the body is scrimped of fuel it can only keep up its temperature by the combustion of part of its own tissue. The muscle and fat will be consumed instead of the food. The most pressing danger of starvation is that the body temperature may fall to a point below that compatible with life. Most of us know how difficult it is during a long railway journey in cold weather to keep warm when unable to obtain a suitable meal at the proper time. The hungrier we get the colder we grow. And no sooner have we partaken of a good meal than the

warmth returns, and the discomfort disappears. At one time it was supposed that foods should be divided into heat-producing and work-producing, or flesh-forming foods. And on this assumption it was supposed that certain foods were more suitable than others for those who had to endure excessive cold. This, however, rests on a fallacy, and we are now aware that the best food for heat-production is also the best for work-production. I have no time to discuss the best form of dietary. That will, I understand, form the subject of a subsequent lecture of this course.

2. In order to promote the combustion of our food and the production of heat, we must do *work*. Consequently we must take a certain amount of *exercise*. In a condition of rest the body surrounded by a cold atmosphere would give up more heat than is compatible with the preservation of the heat-balance. We all know from experience the chilling effect of enforced idleness in the open air on a cold day, and the feeling of pleasant warmth and comfort which is associated with active exercise. During rest or idleness the furnace-fire flickers and dies down, during exercise it is fanned into activity and sets the whole organism aglow.

3. We must further take means to prevent the too rapid loss or absorption of heat. This is mainly effected by the use of *appropriate clothing*. Warm-blooded animals, birds and mammals, are provided with a natural covering suitable to their circumstances, the purpose of which is to prevent the too rapid loss of heat. The feathers of the bird and the wool of the sheep form layers over the body which conduct heat badly. Through these the heat passes slowly into the cold atmosphere, and the heat-withdrawing influence of the surroundings is greatly diminished. All the lower animals are more or less provided with such a covering—feathers, hair, fur, wool, &c. Even the pig, though nearly destitute of hair, is provided with a very thick epidermis, and the whale, though quite hairless, has an enormously thick layer of fat, which serves the same purpose. Man, on the other hand, has no such provision. He has to trust to his intelligence to provide himself with the covering nature has omitted. And though his intelligence guides him fairly well in the main, in this matter, it cannot be said that his methods are always unimpeach-

able. The chief purpose of clothing is to retain the heat which the combustion of the food has produced. It diminishes the heat lost by radiation and conduction. The three prime qualities of heat-preserving clothing are :—

1. It should conduct heat slowly.
2. It should be light.
3. It should fit comfortably.

The first two qualities are provided in the various forms of woollen clothing. Hence wool should form the staple material of heat-preserving clothes. Besides being light and a slow conductor of heat it has also the valuable property of freely absorbing perspiration from the skin, and giving it off gradually by evaporation from its free surface. Accordingly these qualities render it peculiarly adapted for clothing, both in winter and summer—in warm as in cold weather. For while in warm weather, it will absorb far more perspiration than linen or cotton, thus preventing the damp feeling as well as the risk of chill from non-removal of the sweat; in cold weather it acts as an efficient conservator of the animal heat.

I cannot too strongly insist upon the value of the regular use of woollen underclothing, summer as well as winter. I am certain that if mothers saw that their children, especially their daughters, were so clothed they would have less trouble with coughs and colds and the many more serious consequences of chills. I am quite sure that if you paid a little more to your woollen-draper, you would pay much less to your doctor.

4. In the last place the satisfactory regulation and preservation of heat depend in a very important way on proper *attention to the condition of the skin.* I have told you how important is the function of this structure in the regulation of bodily heat. It is then of the highest importance that it be kept in a healthy state. Now, this state is best preserved by the abundant use of soap and water. There are, I am sorry to say, some people to whom baths are as angels' visits. For long periods the skin of the body generally is never washed, the products of perspiration are allowed to accumulate, the glands get plugged up, and the whole tissue gets disorganised. Nothing is of more importance to the heat-regulating mechanism than the daily use of a cleansing bath. The free ablution of the skin by water colder than the body,

FOOD AND DRINK, AND THEIR RELATION TO THE WELL-BEING OF THE PEOPLE.

By Dr J. M'GREGOR-ROBERTSON, M.A.

On the evening of Saturday, 22nd December, Dr J. M'Gregor-Robertson, M.A., Glasgow University, delivered the seventh and last lecture in the Free Assembly Hall on the above subject. Dr Byrom Bramwell occupied the chair.

Dr M'Gregor-Robertson said:—Mr Chairman, Ladies, and Gentlemen,—The subject which I have to bring before you to-night is one which might well occupy our consideration, not for one hour only, but for a good many consecutive hours. I am afraid, indeed, that if I were to attempt in any way to give an exhaustive consideration to it, it would prove exhaustive, not really of the subject, but only of your patience. I shall, therefore, proceed at once, without any preliminary remarks, to the subject by asking, and attempting to answer, first of all the question, What is food? I shall try to answer that question by using a much worn illustration, but one which, I think, is not only good simply as an analogy, but good also because it fairly represents to us, or pictures to our minds, the true scientific basis on which the answer to this question—What is food?—can be given. The illustration is the illustration of a steam-engine, and I am supposing that we have in a builder's yard a steam-engine constructed on the best and most scientific principles. We all know that that engine, however well constructed, will stand in the maker's yard till the crack of doom without moving a wheel or turning a pinion, unless something is supplied to it other than the mechanism of which it consists. That something we call energy or the power of doing work. It has, as it is finished, no power of doing work.

FOOD AND DRINK, AND THEIR RELATION TO THE WELL-BEING OF THE PEOPLE.

By Dr J. M'GREGOR-ROBERTSON, M.A.

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How do we supply to the engine that energy or power of doing work? We all know the answer to that question. Fuel—coal—is put into the furnace, the fire burns, the heat plays round the iron tubes, steam is raised from the water in the boiler, the steam is collected there, and, not being at liberty to escape, is soon at high pressure; the steam at high pressure, when allowed by the opening valves to escape into the cylinder, moves the piston-rod, and the piston-rod moves the wheels. The power of doing work possessed by the steam-engine is derived from the coal, through various stages, by its burning in the furnace. Now, I wish to direct your attention to what this burning of coal implies, because in it we shall find the gist of the argument I wish to follow to-night. Coal consists, the chemists tell us, three-fourths of an element called carbon. Now, that carbon has a great attraction or affinity for a gas in the atmosphere called oxygen. When the carbon is placed in such a situation that it can combine with the oxygen of the atmosphere, the result of the chemical combination is the development of an enormous quantity of heat. The result of the fierceness, so to speak, of the force with which the particles of oxygen and carbon collide with one another, on entering into combination, is to produce heat, and it is the heat which is applied in order to raise the steam. For example, I have in this jar some of that oxygen gas, and I have here on the end of this handle a piece of carbon—wood charcoal. This is a familiar experiment, and all of you, I daresay, have seen it more than once, but I do it to-night simply to fix the fact in your memories. When I simply cause the end of this piece of carbon to ignite in the air it will burn slowly, very slowly in atmospheric air, but when I plunge it into the jar of oxygen it burns fiercely. The carbon—the wood charcoal—unites with the oxygen in the jar, and forms a combination of carbon and oxygen, called carbonic acid gas. We shall find, or could find if we chose to examine it when this carbon is burned out, that then the jar contains a large quantity of carbonic acid gas, so that it can no longer support combustion. Well, it is this combination which produces the energy, the power of doing work in the steam-engine. It is derived, as we see, from heat applied to water to raise steam, but that heat arises or results from the chemical combination or the chemical union of the two elements. Now I can show you

this chemical combination producing heat in a still more remarkable way, in order, further, to fix it in your memories, by taking some iron wire, the ends of which I dip into a little sulphur, and then set fire to, to obtain a glowing point. Then I plunge this into another jar of oxygen (applause), and the ferocity, to use my former expression, of the chemical combination causes the iron wire to melt with the fervency of the heat produced. I simply show you this illustration to fix in your minds this one elementary fact that the power of doing work, possessed by the engine, is derived through several changes from heat, and that that heat is derived from the chemical combination, in the furnace of the steam-engine, of the carbon in the coal with the oxygen obtained from the atmosphere. Suppose the steam-engine, then, supplied with the power of doing work in this way. It expends its energy by pulling the waggons attached to it, and we know further that the amount of work which the engine is capable of performing will depend upon the quantity of fuel consumed within the furnace, that there is an absolute relationship between the amount of work the engine can do and the amount of fuel consumed, the amount of chemical combination going on in its furnace. There is one other thing I wish you to notice in regard to the steam-engine. Let us suppose it is doing work, has done work for days, weeks, months, or years. We all know that the engineer requires to give daily attention, oftener even than once a day, to his engine, in order to see that its various working parts are not suffering from tear and wear. He requires to inspect it regularly in order to discover the slightest flaw in its structure, so that he may not be confronted some day with a catastrophe in the shape of a breakdown. In short, the doing of work implies not only expenditure of fuel in the furnace, but the waste of the working parts of the engine; and in order that the engine may be kept in good working condition, not only must he supply fuel, but he must also repair the waste.

Now, if we turn from the steam-engine to the human body, we find that the human body is also a machine for doing work. I think that is a physiological definition of a practical kind; and by "doing work" I do not necessarily imply manual labour only, though that of course is apparently the most pronounced way in which the human body can do work. But even the human body

which is at rest—a man lying, for example, perfectly still in bed —is doing work. The heart is beating regularly—60, 65, 70, or 75 beats a minute. The chest is regularly rising and falling by the movement of respiration. Blood is regularly, through the action of the heart, coursing through the vessels of the body. The person may be lying awake, uttering no sound, but his eyes may be open and continually moving round the room, and he may be taking note of the pattern of the paper on the wall or the roof. Or he may be lying with eyes closed, quietly meditating on some problem which may have been troubling him in business, in literature, or in mathematics. In all these ways the man is doing work—his heart is doing work, the muscles of his chest are doing work, the nerve cells of his brain are doing work—and work cannot be done unless at the expenditure of energy. In order to give you an illustration of the actually large quantity of work a man may do while he seems to be doing no work at all, let me give you a calculation of the amount of energy expended by the heart alone in one day. I need not take you through the details of the calculation, but we will suppose that the heart is beating 75 times a minute, and that at every beat it ejects into the main artery of the body 6 oz. of blood. These arteries are already filled with blood, and therefore room requires to be made for the additional 6 oz. of blood by the dilatation of the arterial walls. Therefore the heart, in expelling 6 oz. of blood at every beat into the main artery, does so against resistance, and it is therefore doing work of a considerable amount. A calculation has been made that the heart only, working quietly and steadily in this way, expends a quantity of energy in twenty-four hours, which, if applied to lift a weight, would lift one ton 2400 feet into the air —one ton nearly half a mile into the air. If we add to this the work done by the muscles of respiration, and the energy expended in the form of heat, we find this enormous result that there is daily being expended in the human body, when that human body is at rest, a quantity of energy, which, if applied to lifting a weight, would lift a man's body—that is to say 150 lbs.—nearly eight miles into the atmosphere. There is then daily being expended by this human machine, merely in the daily work of life—no external work being performed—an enormous quantity of energy. That energy must be obtained from

somewhere or other. We shall see immediately whence it is derived.

In the next place, with the working of the heart, and so on, even when the body is at rest, there is waste of tissue going on in the body,—waste of the muscular substances of the heart, waste of the nerve substances of the brain,—waste of tissue in all the organs of the body, more or less, is going forward daily. Now, just as in the steam-engine, the quantity of fuel is regulated according to the work done by the engine, so is it in the human body. In addition to this amount of internal work which the body is doing, there is also external work done in the shape of manual labour, or in any of the other forms of expending energy that I have spoken of. This implies a much larger expenditure of energy than I have already stated to you. We see, then, that the human body, just as an ordinary engine, expends energy in the doing of work, and also undergoes waste; and that if the human machine is to be kept in good working order, the material for the supply of the energy must be given to the body daily, and secondly, material for the repair of the waste must also be provided. These are the two functions which food performs; and we may therefore now say food is material which will either yield energy for the doing of work by the body, or will yield material for the repair of the waste of the body, or will do both of these. But if any substance whatever does neither of these,—if it neither yields energy nor material for the repair of waste,—it is not entitled to be called food at all. (Applause.) Food, then, is the material which yields substance for providing energy for work in the body, or for the repair of the waste of the body.

Our next question is, What is necessary for yielding energy to the body? How does the body obtain energy? What kind of material must be supplied to the body in order that it may obtain energy from it? It has been shown—and I need not detail the process, which would take me too long—that energy is yielded to the body just in the same way practically as energy is given to the steam-engine. We have seen that energy is given to the engine from combustion—from heat—and we have seen that heat is derived from a chemical combination. In the same way energy is obtained for the body. Operations go on within the human body the same in their essential nature as the operations I have

shown you going forward in that glass jar. Material is given to the body which is capable of combining with oxygen, and the action of chemical combination produces within the body heat, and from that heat energy for doing work may be obtained. Energy in the human body, then, is the result of chemical combination in the body, that being chiefly a combination of carbon with oxygen—carbon supplied in the food, oxygen supplied from the atmosphere by the air which we breathe.

Well, then, in the next place, what kind of substances yield material for repair of waste in the body? We know that if a mechanic is repairing the various parts of a steam-engine, he would not repair the boiler, for example, with a piece of wood, he would not fill up a hole in the side of a boiler plate with a mass of plaster, he would not repair a crank-shaft with a piece of whalebone. He would take the same sort of material as that which formed the structure he was repairing, and would replace the damaged steel plate of the boiler with a new steel plate, and so on. He considers what is the substance, what is the material made of which he wishes to repair, and then he has an indication of what substance he must use in order to repair it. Well, if we are to repair the waste going on in the human body, we must ask ourselves what is the chemical composition of the human body, of what substances is the human body formed, in order that we may know what to supply to it in order that its repair may be effected. Therefore, we go to the chemist and say, What does the human body consist of? and when we have obtained that information we can say what substances will yield to the body material for the repair of its wasted parts. I have here a diagram representing the chemical constitution of the human body, and we find that the human body consists of over 60 per cent. of water, 18 per cent. of substances called proteid, 15 per cent. of fats, and a very small percentage of substances called carbohydrates (sugars and starches), and also some saline material—salts of lime, salts of magnesia, and so on. I wish you to note these three substances—protein, fats, and carbohydrates—for a moment, so that we may see what they are formed of. Let us take the fats and carbohydrates first. These are composed of three elements: carbon, a solid,—you saw the piece of carbon I used there,—hydrogen, a gas, and oxygen, the gas with which I performed the

experiment at the beginning of the lecture. These three elementary bodies in chemical combination of a peculiar kind form fats, starches, and sugars. Fat, starch, and sugar contain only these three elements—the same three elements. We may say that it is the way in which the three elements are built together which determines whether the product shall be a fat, or a sugar, or a starch. To take a familiar illustration, you might have a pile of bricks, and a pile of wood, and a pile of nails, and a mass of mortar, and you might say to an architect, "Take the mortar, and the wood, and the bricks, and the nails, and make them up into a building for me." He will construct, according to his own fancy, a building, it may be a square building or a round building —a school, cottage, or tower. And you may say to another architect, "There are the same materials, make a building for me." He may make a building of an entirely different shape, and of an entirely different character. Just as with the bricks and the lime, and so on, you can make different forms of buildings, so in the great laboratory of nature the three elements—carbon, hydrogen, and oxygen—are built together in different ways, and as the result you have in nature's great laboratory produced fats, starch, or sugar. These are built of only these three substances—carbon, hydrogen, and oxygen. But if we take the substance, protein, we find that it is in marked contrast to the fats, sugars, and starches, in this that it contains another element, namely, nitrogen, which is a gas, forming 79 per cent. of the atmosphere. All proteids differ from the other substances in containing this element, nitrogen. It will assist you if I mention that proteid substances have as their type such a familiar substance as white of egg. Curd of milk is also a proteid. The meaty substances of beef, fish, fowl, and so on, are proteid substances. Well, then, we find the human body consists chiefly, taking it in its elements, and excluding salts, of four elements—carbon, hydrogen, oxygen, and nitrogen. It is therefore plain to us that if we are to supply to the human body material for its repair, we must supply all these four elements—carbon, hydrogen, oxygen, and nitrogen. There are several substances which contain carbon, hydrogen, and oxygen, namely, fat, sugar, and starch, but these contain no nitrogen. These bodies are not able, therefore, to repair the waste of the human body, because they are

deficient in this element, nitrogen. It is therefore only the proteid bodies, the white-of-egg-kind of substances, what we are apt to call meaty substances, which can yield all the elements necessary for the repair of the human body. So that it comes to this, that for the yielding of energy to enable the body to work, we must supply to the body substances containing carbon; and in the second place, for the yielding to the body of material to repair its waste, we must supply nitrogen, and if we supply substances containing these two elements, then we have done all that is necessary to enable the body to do work, and to enable the body to repair its waste. (Applause.)

Our next question is, What quantity of these substances is necessary? Now most elaborate experiments have been performed in Germany to answer this question, and I shall have to tell you how the experiments have been performed, and how the answer has been forthcoming. Professors Pettenkofer and Voit, of the University of Munich, prepared a chamber in which a man could live—an air-tight chamber—and they had pipes leading into that chamber by means of which they could supply fresh air, the quantity supplied being measured through meters. They had pipes by which to withdraw the air, meters for measuring it, and also chemical apparatus for testing it. They put in a man, a watchmaker, into this chamber; they weighed him before he went in, and for the first day they made him rest from working. They estimated the quantity of food he had, the quantity of air he had, by which they could calculate the quantity of oxygen he derived from the atmosphere. They calculated the various products that were given off from his body in the course of twenty-four hours, and, at the close of the day, they weighed him to discover whether he had gained or lost weight. By experiments such as these they could discover what quantity of food was necessary to keep that man in a resting state, so that he might neither gain nor lose weight. On another day they set him to do light work, such as mending watches, which was his occupation, and by the same process they determined how much more food he required to do his work without gaining or losing weight. Then they gave him harder work to do, and they estimated again the extra supply necessary to prevent him losing weight. By experiments such as these and others, varied in all sorts of fashions, and by

other observations, it has been determined that a healthy man, doing an ordinary amount of work, needs per day 300 grains of nitrogen and 4800 grains of carbon. If he gets these two quantities supplied to him he will be able to expend energy in the doing of a good day's work, and be able to repair waste of tissue that has been involved; and at the close of the day he will be in the condition he was at the beginning of the day, without having gained or lost.

Well, you see a man needs 300 grains of nitrogen and 4800 grains of carbon. Nitrogen is a gas, to all appearance not different from the gas I had in this jar. Carbon is a solid. This bottle of wood charcoal contains the quantity necessary for a man doing a day's moderate work—4800 grains. Nitrogen being a gas, 300 grains would fill an enormous amount of space. Is it enough, then, to supply a man with these beggarly elements, which I have stated, this Barmecide feast of a balloonful of nitrogen and this quantity of carbon, and say, "There you have enough to do your day's work upon?" No, it is not enough to do that, for a man cannot make use of the beggarly elements. I can illustrate the case thus:—A gas-engine is not built for the consumption of coal, neither is the ordinary furnace in a steam-engine, constructed for burning coal, a good kind of engine for burning wood. The human body is not designed for the consumption of materials in these raw forms. We require the elements, carbon and nitrogen, to be worked up into forms in which the human body can use them. Now, these substances are worked up by the living creation beneath us. The grass growing on the meadows sucks up water containing dissolved salts from the soil, and also ammoniacal substances from the soil containing the nitrogen. It takes the carbon from the atmosphere, and works these up in its own body into proteids, fats, starches, &c. The grain growing in the fields takes the beggarly elements of water, ammoniacal substances—nitrogen—from the soil, carbon from the air, and works these beggarly elements up into the substance, the tissue, of its own body, forming of them fat starch and this proteid or albuminous body which I have spoken of. Then the cows and the sheep crop the herbage. They take this material, worked up so far, introduce it into their own body, and work it up into higher forms; and

man uses the barley and the oats and the potato—which have been the first manufacturers of nature's raw materials—man takes the barley and oats and potato, and he makes use also of the sheep and the oxen, and introduces the material they have worked up in their body and builds it up into the higher structure of his own frame. (Applause.)

Thus we need the elements prepared in a fit shape for our use; but if the substances which we take do not contain these elements I have mentioned, then they cannot yield to us, however palatable they may be, however beautiful to the eye, however attractive otherwise, they cannot yield to us either the material upon which we can work or the material by which we can repair our wasted tissues.

In what forms, then, do we find carbon and nitrogen worked up for our use? The following tables will show you the chief forms of foods that contain these elements :—

CARBONACEOUS FOODS.

Starches.	Sugars.	Fats.
Sago.	Cane Sugar.	Butter.
Cornflour.	Grape Sugar.	Dripping.
Arrowroot.	Beet Sugar.	Lard.
Tapioca.	Treacle.	Butterine.
	Golden Syrup.	Oils (Olive, Almond, &c.).
	Honey.	

These food stuffs contain the carbon worked up into the form in which it can be made use of by us with profit, but they do not contain the nitrogen. While they can yield us energy for doing work, they cannot yield what will repair the tissues.

Now look at this table of nitrogenous or proteid substances:—

From Animal Kingdom.	From Vegetable Kingdom.
Butcher's meat of all kinds.	Beans, peas, lentils.
Poultry.	Wheat, oats.
Wild fowl and game.	Flour and oatmeal.
Fish and shell-fish.	Rye, barley, Indian corn.
Eggs.	Rice, potatoes.
Milk.	Vegetables and fruits of all kinds.

There is here a large assortment of substances which contain

carbon and nitrogen worked up into a form in which they are fit for use. (Applause.) Now you see the problem is to take such a quantity of these carbonaceous and nitrogenous food stuffs as will yield us the 300 grains of nitrogen and the 4800 grains of carbon. Well, you have seen that there are some food stuffs which do not contain the nitrogen. Suppose we ask ourselves, Can we take any one single food stuff and derive from it alone the material for yielding energy and repairing waste? It is plain, since these carbonaceous food stuffs contain no nitrogen, we cannot obtain from one of these food stuffs alone all that is necessary for our daily work and the repair of waste tissue. But we have seen that meat, game, eggs, and rice contain both carbon and nitrogen, and therefore we may ask ourselves the question, Is it possible for us to derive from one of these food stuffs alone sufficient to yield the needed energy for work and the needed repair of tissue? Now, that resolves itself into this question, Does any one of these food stuffs contain the carbon and the nitrogen in the proportion of 4800 grains of the former to 300 grains of the latter? If we take a pound of rice, or a pound of potatoes, or a pound of butcher's meat, can we obtain from it the carbon and the nitrogen in their due proportions? For observe what is the result of taking a substance as food which will yield carbon or nitrogen not in due proportion. Take, for example, butcher's meat. Four pounds of butcher's meat will yield to us the 4800 grains of carbon that we want, but it contains 1200 grains of nitrogen. That is to say, 4 lbs. of butcher's meat gives us just the quantity of carbon we need, but four times the quantity of nitrogen. What is the result of taking 4 lbs. of butcher's meat into our bodies? We have introduced 900 grains of nitrogen more than we require, and that puts upon the body the necessity of expelling that 900 grains in excess. We impose unnecessary labour on the organs of the body, upon the digestive organs at the beginning and the eliminating organs at the end, in order to dispose of this that is not needed, that the body cannot use. That is not an economical thing to do so far as our bodies are concerned. We should introduce our food in the form that will give to the body the necessary quantity of carbon and nitrogen, and no more. If, on the other hand, we consume an excess of carbon, the body stores it up in the form of sugar or fat or starch,

and it is not desirable to be continually adding to our store of fat or sugar or starch. Probably the form in which it would be stored up would be fat, and that is not desirable. Therefore, the problem is to introduce just the quantity of food which contains the due proportion of the two ingredients. This table will show you whether it is easy to get a single food stuff which will yield these substances in the proportions I have named.

To obtain 300 grains nitrogen, a person would require to eat of—

Cheese, nearly .	12½ ounces.	Wheaten Bread.	46⅓ ounces.
Lentils . . .	15¾ „	Rice	82 „
Peas	18½ „	Rye Bread . .	92 „
Beef	19½ „	Potatoes . . .	20 pounds.
Eggs	31 „		

To obtain 4800 grains carbon, a person would require to eat of—

Rice	18⅓ ounces.	Rye Bread . .	30 ounces.
Wheaten Bread	20 „	Cheese . . .	64½ „
Lentils . . .	26 „	Potatoes. . .	65½ „
Peas	26⅕ „	Beef	4½ pounds.
Eggs	29 „		

For instance, this table shows that to obtain 300 grains of nitrogen, a person must eat 12·4 oz. of cheese, nearly 1 lb. of lentils, 2½ oz. more than 1 lb. of peas—1 lb. 3½ oz. of beef, or 31 oz. of eggs. To obtain the amount of nitrogen, a man must eat 31 oz. of eggs. Now, an egg contains about 1½ oz., so that for repairing the waste he would need to eat 20 eggs per day. Again, 46 oz. of wheaten bread would be required—that is very nearly 3 lbs. of bread. The ordinary small loaf is 2 lbs., so that he would require to eat a loaf and a half; while 82 oz. of rice or 20 lbs. of potatoes are necessary in order to yield the amount of nitrogen necessary to repair the tissue waste. Now, if we look at the other side of the question, and ask how much must be eaten in order to obtain the necessary carbon, then we find that 18 oz. of rice will yield 4800 grains of carbon; of wheaten bread, 20 ozs., of lentils, 26 oz., and 4½ lbs. of beef, are necessary to yield the carbon. So that while a little over 1 lb. of beef

will yield the necessary nitrogen, one would need to eat 4½ lbs. of beef to get the carbon. It is plain, therefore, that not one of these articles of diet would be suitable to live on alone, and that because they do not contain the necessary amount of carbon and nitrogen in due proportion.

Our question, then, is, How can we obtain from foods that due proportion of the two elements necessary without taking an excess, that is economically, so far as the body is concerned? I show you a diagram which illustrates to you some of the apparent anomalies of food-stuffs. It is a diagram showing the composition of various foods. Each food-stuff is represented by a band, one part of which is black, another red, another blue, another white. The whole length of the band stands for 100 parts of the food-stuff, the black portion indicates the water it contains, the blue the proteid material, the red the carbohydrates, and the white the saline constituents, and the length of each of these parts represents the proportion of that ingredient in the 100 parts. So that at a glance you can perceive the various ingredients of each food-stuff and their relative proportions.

What we find, for example, in this diagram is that beef consists to the extent of 62 per cent. of water, only 12 parts of protein, and 20½ of fatty substances. Milk contains 86 parts of water, 4 of protein, and 8 of sugar and fat. Now take vegetable foods, and look at peas. There are only 14 parts of water in peas, 23 of proteid substances, 2½ of fats, and over 57 of starch, while oatmeal contains only 7½ parts of water in 100, 15½ of proteids, 8 of fats, and 68 of starch. Wheaten bread contains, it appears, 33 per cent. of water, 9 of proteids, 2 of fats, and 55 of starch, and so on; while every 100 parts of rice consist of 13 of water, 7½ proteids, ½ fats, and 78½ of starch.

When you thus compare rice, peas, and wheaten bread with their small proportions of water and large proportions of nutritious material, and pork, fowl, and animal foods with their large quantities of water and their small percentages of nutritious material, you have the reason for the greater nutritive value of one as compared with the other, and the greater economy of the one as compared with the other. But that I will speak of later. You also readily see from the diagram that a substance like rice contains a very large quantity of carbonaceous material in the form of starch

(nearly 80 per cent.), and a very small quantity of the nitrogenous element, and that the relative proportions of these two constituents is very different in the various food-stuffs. You will then perceive the reason for combining two different food-stuffs. Since you cannot get the carbon-containing and the nitrogen-containing substances in due proportion in almost any food-stuff, it becomes necessary to combine two food-stuffs, one rich in the former, the other rich in the latter, in order to secure a proper quantity of each element. Supposing you combine rice with beef. The rice yields carbon in abundance in the form of starch, but little proteid material, while the beef makes up the deficiency of proteid while supplying little carbonaceous substance.

Now, I have said the proportion of the two elements necessary are 300 grains of nitrogen and 4800 grains of carbon; but we must now speak, not of the elements themselves, but of their combination in food-stuffs. We shall speak of the foods which contain carbon but no nitrogen as non-nitrogenous food-stuffs, and we shall speak of the foods that contain nitrogen as well as carbon as nitrogenous food-stuffs. And when we compare these food-stuffs together we find that the proportion of 300 grains of nitrogen to 4800 grains of carbon could be obtained only from a food-stuff which contained its proteid ingredients (nitrogenous) in the proportion of 1 to every $3\frac{1}{2}$ or $4\frac{1}{2}$ of its non-nitrogenous ingredients (fats, sugars, and starches). You will understand better what is meant, and how far short of the due proportion most food-stuffs are, if I refer you to the next table. In it is set forth the proportion of the nitrogenous to the non-nitrogenous constituents in different substances according to Liebig:—

	Nitrogenous.	Non-Nitrogenous (reckoned as Starch).
Veal,	10	1
Beef,	10	17
Peas,	10	23
Fat Mutton,	10	27
Cows' Milk,	10	30
Human Milk,	10	37
Wheaten Flour,	10	46
Oatmeal,	10	50
Potatoes,	10	86
Rice,	10	123

In veal we have 10 of nitrogenous substances to 1 of non-nitrogenous. Peas have 10 nitrogenous for every 23 of non-nitrogenous, that is to say, peas contain too much of nitrogen-containing substances, and too little of carbon. If we come to cows' milk we find the proportion 10 to 30, that is 1 to 3. I have said the due proportion should be 1 to $3\frac{1}{2}$, and therefore cows' milk contains nearly the due proportion of nitrogen and carbon. Wheaten bread contains almost exactly the proper limit of the proportions I have mentioned, and oatmeal contains 1 to 5. Rice contains 1 to $12\frac{1}{3}$. Of these substances only three have the necessary elements in anything like the proportion required by us, namely, milk, flour, and oatmeal. The former contains too much nitrogen in proportion to carbon, but that, as we shall see, makes it all the more suitable for infants' diet, while the latter is rather rich in carbon, but just on that account affording a diet unexcelled for hard work, because yielding the material for the liberation of energy in great abundance, while also supplying material for the repair of waste. These illustrations show that most substances are either specially rich in nitrogen, or specially rich in carbon, and if we take a due admixture of the two, we shall have a healthy diet which shall yield them in the proper proportions—a mixture of oatmeal and milk forming an exact proportion.

The next question comes to be, How are we to get these substances, carbon and nitrogen, worked up in suitable form at least cost? And here there comes into the problem as determining the answer to this question, the large percentage of water which some substances contain as compared with others. If beef contains 62 parts of water in every 100, it is plain that when you are buying beef you are buying more than one-half of water, you are paying for a large quantity of water which you do not want, and are getting consequently less of nutritious material which you do want. If, however, you buy a pound of peas you get only 14 parts of water. Therefore, suppose peas and beef were the same price per pound, you would be much cheaper to buy a pound of peas than a pound of beef, because when you buy a pound of peas you buy 60 parts less of water than when you buy a pound of beef.

Now, to make that still more plain, I have had painted

a table which puts it in this form—"What a penny will buy."

I have constructed this table by taking the chemical composition of these various substances, and considering the quantity of water they contain per pound, or what percentage of water they contain. For instance, I have estimated one pound of beef to contain only $32\frac{1}{2}$ parts of nutritious material. When I say, as I do at the top of this list, that a penny will buy $12\frac{3}{4}$ oz. of nutritious material in the form of Indian corn meal, I mean this, that a penny will buy 1 lb. of Indian corn meal—that is, 16 oz.—but $3\frac{1}{4}$ oz. of that 1 lb. consist of water. The remaining $12\frac{3}{4}$ oz. consist of fats, sugar, starches, and proteids available for the nutrition of the human body. Now, I therefore cast aside the water, so to speak—deduct it from the 1 lb.—and that shows that 1d. expended on buying 1 lb. of corn meal buys $12\frac{3}{4}$ oz. of nutritious food in the form of fat, starch, sugar, and albuminous substance. A penny will buy 8·6 oz. of nutritious material in the form of ryebread; 7·1 in the form of potatoes; 6·8 oz. in the form of flour, and so on. It gives 7·1 in the form of oatmeal. You remember oatmeal is 2d. per lb.; 1d. buys $\frac{1}{2}$ lb. of oatmeal—that is, 8 oz.—but we exclude a certain proportion which is water, and the result is that we have fully 7 oz. in the form of fat, sugar, starch, and proteid subjects. When we come to cod fish, 1d. will buy barely 1 oz. of nutritious material in the form of cod fish, although cod fish be selling at 3d. per lb. I have added a certain percentage to the price of the fish, because a considerable portion will be waste in the shape of bones and skin, and I have considered that 1 lb. of fish, excluding bones and skin, would cost $4\frac{1}{2}$d. instead of 3d.

What a Penny will Buy.

		Nutritive Material in Ounces.	
1d.	will buy	12·8	as Indian Corn Meal.
1d.	,,	8·6	as Rye Bread.
1d.	,,	7·1	as Oatmeal.
1d.	,,	7·1	as Potato.

		Nutritive Material in Ounces.	
1d.	will buy	6·8	as Fine Flour.
1d.	„	6·4	as Pease Meal.
1d.	„	6·3	as White Bread.
1d.	„	6·2	as Sago.
1d.	„	5·9	as Peas (dried).
1d.	„	2·9	as Figs (dried).
1d.	„	1·8	as Buttermilk.
1d.	„	1·3	as Bacon.
1d.	„	1·3	as Milk.
1d.	„	·9	as Cheese (Dunlop).
1d.	„	·8	as Cod Fish.
1d.	„	·4	as Egg.
1d.	„	·3	as Lean Beef.
1d.	„	·3	as Fowl.
1d.	„	·3	as Salmon.

You see, then, how we answer this question as to getting the necessary quantity of food at least cost; and we find briefly this, that you will get for the same money twenty times the amount of nutritious material in the shape of oatmeal that you will in the shape of lean beef. One penny expended on oatmeal will buy twenty times the quantity of nourishing material that it will yield if expended on beef. (Applause.)

I have shown you, then, what food is. It is material which will yield to the body energy for its work, and material for the repair of its waste tissue; the energy-yielding material must contain carbon, the tissue-repairing material must contain nitrogen. These two elements must be worked up for us by the plants and the inferior animals before they can be available for our use. We need 300 grains of nitrogen worked up and 4800 grains of carbon. There are very few food-stuffs which singly will yield that amount of carbon and nitrogen in that proportion—in fact, one may say only three, milk, flour, and oatmeal; and then we find, when we come to consider the cost, that the vegetable foods such as oatmeal and so on, will, at less cost, yield far more nutritive material of the right kind for the body than animal food.

Supposing, then, in these forms the necessary quantity of carbon

and nitrogen are yielded, is anything else wanted to keep the human machine in a healthy state? There are salts needed—common salt and other salts. These, however, I may dismiss with the remark that they are contained in all food stuffs. Beef contains 5 per cent. of saline material, and all the foods have it—rice ½ per cent., peas 2·5, and so on. We may say we get these salts readily in the food itself, or by the universal practice of adding salt to please the palate.

What else, then, may be required, provided the carbon, the nitrogen, and the salts are provided? I should, of course, say we need oxygen, but I must not consider that further to-night. We get it to some extent in our food, and what additional supplies we need we obtain from the atmosphere by the process of respiration. What more, then, do we require? We need water, and provided we have obtained the needful quantity of carbon and nitrogen, the necessary quantity of salts, and the needful supply of oxygen, the human body needs absolutely nothing else to keep it in working order than a daily supply of water to meet that which is given off daily by perspiration, &c. The needful daily quantity is about 60 oz. per day; but, as we have seen, all the foods we take contain water to some extent, and therefore it is not the 60 oz. that we require to introduce as drink, but simply that quantity which will make up the deficiency in the food.

These, then, are the physiological facts as to foods, so far as I can lay them before you in the short time at my disposal—that, given these necessary ingredients, carbon, nitrogen, proteid, and oxygen, we need only further water in a certain quantity to supply us with all our daily wants. We are, however, face to face with this fact, that human beings not only require what is necessary but crave for what is pleasant, for what supplies a change, for what gives variety. Some of us, at least I believe a large number of the human kind, object to introduce liquid simply in the form of water. There is a sameness in it which palls upon them, and there has been a universal demand over the whole globe, a demand for some liquid substances, which will meet the physiological requirements of the body by introducing water, but will also meet the essentially human demand for variety. I have only a brief minute or two to consider this question; and I observe there are two questions which we must

ask ourselves in considering the subject of drink. Assuming that the drink introduces the necessary quantity of water that we require, the first question we may ask in regard to it is, Does it besides supply to the body any nourishing material? besides supplying the water, does it supply us with any food? and the second question we may add is, Supposing it supplies to the body water in a palatable form, supposing it may or may not supply also a slight quantity of nourishing material, does it besides supply anything which will act upon the body in a manner beneficent or hurtful? Now, the drinks that are in common use—excluding, for a moment, milk, as I consider it essentially a food-stuff—are tea, coffee, and cocoa belonging to one class, and then we may class all other drinks as alcoholic beverages. Lemonade and soda water are to be considered only as varieties of water.

Then we have tea, coffee, and cocoa, and secondly alcoholic drinks. Our first question in regard to them is, Are they food-substances? do they introduce anything of use for nourishing the body? Does tea, besides introducing water, give the body anything which will yield energy for its work or material for the repair of tissue? Well, we go to a chemist and ask him, what does a cup of tea contain? or rather we take a teaspoonful of tea and infuse it in a teapot for three minutes, and pour out the infusion and hand it to a chemist, and ask, what does that contain? —for it is not necessary that the chemist should take the tea leaves, as we only drink the infusion. So we say, what does this infusion contain? and the chemist answers practically what I show you in this table.

CONSTITUENTS OF ONE CUP (7 OUNCES OF TEA) CONTAINING AVERAGE AMOUNTS OF CREAM ($\frac{1}{2}$ OZ.) AND SUGAR (100 GRAINS).

	(Attfield.) Grains.
Cheesy matter from the Cream,	5
Fat and Milk Sugar,	30
Added Sugar,	100
Mineral Matter of the Cream,	1
Extract of Tea Leaf (mineral matter, $4\frac{3}{4}$; organic, $6\frac{1}{4}$),	21
Total,	157

We are considering only the tea infusion, and setting aside the nutritive material derived from the cream and sugar. We have, briefly, in a cup of tea 21 grains of material. The 21 grains consist of $4\frac{3}{4}$ grains of ash (mineral substances), and $16\frac{3}{4}$ grains of organic substances. It is with the latter we are concerned. What are they composed of? In the first place, $16\frac{3}{4}$ grains are scarcely worth taking into consideration. If a cup of tea yields only $16\frac{3}{4}$ grains of organic material, it is not worth considering as a food-stuff at all. But when we examine the organic material we find its chief ingredient is called thein, yielding but one grain of nitrogen. We may say, then, taking it in this strict chemical fashion, that a cup of tea yields to the body in the form of nitrogenous substance 1 grain. It is plain that tea, therefore, has no place as a food-stuff—it yields nothing to the body for giving energy to do work, or repairing waste tissue. What, therefore, does it do, or what is its use? I need hardly describe what it does. It stimulates, it removes or relieves feelings of fatigue; it is useful, in various depressed states of the body, because of this stimulating property. It stirs the imagination, it quickens the breathing, and also the action of the heart. It stimulates in short, and it is this stimulating property that makes it valuable for us, and makes it desired by us. It is not a food, however; as a stimulant it enjoys the advantage, under ordinary circumstances, of leaving afterwards no feeling of depression. It is therefore useful for us as a stimulant, *provided always we supply with it the energy-yielding and tissue-repairing substance.* A meal with tea is therefore a suitable enough meal, provided, in our calculations, we put the tea on its proper level as nothing more or less than a stimulant—it may be aiding the digestion of the other food. It may so stimulate us that we may make due use of food which, owing to our depressed state, we might not be able to take the full benefit of. But if we take tea in order to fill out an otherwise deficient diet, we are deluding ourselves — we are attempting to deceive our human mechanism, and it will not be deceived. If we are taking tea in order to produce satisfaction with a meal which is not a satisfying meal, then we are simply endeavouring by a false stimulation to mask to ourselves the fact that we are not supplying to our human bodies what they need for their work, or for their

waste of tissue. In this respect I compare tea—using again a popular figure—I compare tea, when it is used in this way, to putting a blower on a dying fire. Here are the remains of a fire, nothing but a heap of half-smouldering embers in the grate; we collect the embers together, and put on a blower. The blower creates a draught, which wakens the dying fire, and the flames blaze up with greater brilliance, and present an appearance of warmth, but they blaze up only to die out more rapidly. The blower quickens the consumption without supplying fuel. If, when we put on the blower, we also carefully put on more coal, then we quicken the chemical action going on; but we have also supplied the material with which that chemical action may be satisfied.

Therefore that is the position in which we are to regard tea—as simply supplying stimulus—as useful enough under certain circumstances for its stimulating property, provided we recognise the fact that we must take with the tea the necessary quantity of nutritive material, and not a fraction less. Coffee I need not further consider, because it is on exactly the same basis—it also contains thein, which confers upon it a stimulating property, but it is not nutritious. Cocoa occupies an entirely different position. Cocoa consists one-half of fat, and as such yields material to the body for the liberation of energy for the doing of work. Cocoa we do not drink as an infusion; it is an emulsion or decoction. We do not usually take cocoa and infuse it, and pour off the infusion, having extracted some principle from it, but we mix the cocoa with hot water, and drink the whole mixture, deriving from the powder whatever nourishment it contains. Therefore cocoa is not only a beverage, but also a food, and therefore we may use cocoa as adding something to our meal as able to fill out a meal otherwise deficient.

Lastly, we have the alcoholic drinks. Now this question of alcoholic drinks resolves itself, so far as we are at present concerned, into a question of the alcohol which gives to the drink its peculiar property. Let me refer you to the next table.

PROPORTION OF ALCOHOL IN VARIOUS ALCOHOLIC DRINKS.

	Per cent. (by volume).		Per cent. (by volume).
Brandy, . . .	55·39	Claret and Hock,	8 to 13
Whisky (Scotch), .	54·32	Champagne, .	7 to 12
Whisky (Irish), .	53·20	Edinburgh Ale, .	5 to 6
Rum, . . .	53·68	Porter, . .	5 to 7
Gin, . . .	51·60	Lager Beer, .	5·1
Port Wine, . .	20·25	Cider (average), .	6·0
Sherry Wine, . .	16·30	Gooseberry Wine,	3·0
Madeira Wine, .	16·10	Ginger Wine, .	1 to 6

We see from this table that brandy contains rather more than 55 per cent. of absolute alcohol, Scotch whisky 54 per cent., being apparently stronger than Irish; the stronger wines, port and sherry, contain from 16 to 20 per cent., and the lighter wines, champagne and hock, 7 to 13 per cent.; and Edinburgh ale yields 5 per cent. of absolute alcohol, which would be equal to 10 per cent. of spirit, in the form of whisky, for example. So that 10 ozs. of Edinburgh ale would yield the same quantity of spirit as 1 oz. of whisky. What is the value of alcohol? Is it a food? Well, I cannot go into the details of the question, for it is a large question, and has been a much discussed problem. I can only say briefly that, treating alcoholic beverages—whisky, and so on—on an essentially fair footing, giving them every conceivable allowance that can be, the conclusion arrived at is that alcohol may to some extent give to the body something which will yield energy for work, but not material for the repair of tissue. I say it is a debated question, but taking it on favourable ground, alcohol yields something for giving energy to the body. That admission is restricted, however, by this fact, that if beyond a certain amount of alcohol is consumed it produces deleterious effects on almost all the organs of the body, not only on the glandular organs, such as the liver and kidneys, but on the nervous organs, such as the brain. So that if, on the one hand, we allow that whisky is capable of being to a slight extent an energy-yielding food-stuff, on the other hand we have to add that if any quantity of that food-stuff is taken it is injurious. What is the value of a food-stuff which, if taken beyond a certain very

small quantity, becomes injurious, poisonous? Its value is scarcely worth considering.

There have been experiments made by Dr Parkes, Count Wollowicz, and others, to determine at what quantity danger may arise. They have been made independently, but they seem to point to this conclusion—that the limit of safety is 1oz. of absolute alcohol, not at a time, but during twenty-four hours. Now, taking the composition of whisky as consisting of 54 per cent. of alcohol, it means this, that 1 oz. of absolute alcohol is represented by 2 oz. of whisky, is represented by 5 oz. of sherry, is represented by 10 oz. of light wines such as hock and claret, and is represented by 20 oz. or a pint of beer. If a man, therefore, in twenty-four hours, goes beyond 2 oz. of whisky, which is less than one glass, two glasses of sherry,—I am speaking of the ordinary glass,—four glasses of hock, of champagne, or claret, or one pint of beer, he passes the limits of safety. I am not speaking at all as a teetotaler, neither am I adopting a temperance platform. I am taking simply scientific experiments, and saying that apparently the result of them admits that alcohol may be to a slight extent useful to the body in the way of yielding energy; that if more than the small quantity I have named is taken, injurious effects follow, and that, therefore, we are restricted to these limits, we ought to be within those limits of safety. The effects of alcohol are to stimulate, as we know, and they are followed by a period of depression, which does not follow the use of tea. What I have said about the stimulating effects of tea may be said of the stimulating effects of alcohol. We may represent alcohol as quickening changes going on in the body, changes by which carbon is united with oxygen for supplying energy to the body.

Under certain circumstances, then, alcohol may be useful, but as the use of whisky, save in small quantities, may produce injurious effects in many organs of the body, the use of whisky is not to be advised under ordinary circumstances at all.

I have left very little time in which to point out the practical conclusions from these facts which I have tried to lay before you. Let me point out one. The first remark I would like to make is in regard to the feeding of children, and to point out what I daresay you all know—that children are often fed almost exclusively on such substances as sago, tapioca, cornflour, and arrowroot.

These are substances which contain carbon but not nitrogen. What is the child doing? Not only expending energy, and wasting tissue, but forming new bone, new blood, and new nervous substance. A child, therefore, needs more nitrogenous food than a man does, for a man adds nothing to his stature or his blood —he is full grown, and has only to repair the daily waste. A child has not only to repair his daily small waste of body, but to build up new tissue, and therefore needs a larger proportionate quantity of nitrogen than a man. But many children are fed mainly on such substances as tapioca, sago, cornflour, and arrowroot, which contain no nitrogen. It is on this account we have children running about the streets with legs which bend under them, incapable of supporting their weight. We find them with soft flabby muscles, with pale pinched cheeks and thin skin, because the nitrogen has not been provided from which they may form new blood and tissue, because the diet they are provided with is habitually deficient in the tissue-forming and repairing element. We ought therefore to avoid the dangers to which I have alluded, to exclude entirely from children's diet such substances as cornflour, sago, tapioca, and arrowroot. If I had my way of it, I would put these substances in the druggist's shop, and say they are only to be given to children under orders of the doctor, otherwise, as they are easily cooked, parents are apt to give them to their children, and while apparently thriving, these children will starve on them. You may see a fat overgrown baby who is yet being starved. You are feeding it with cornflour and arrowroot, giving it more carbon than it requires, and yet you are starving it of nitrogen—of the material from which it may form new tissue and new blood. It is a fat child, and people wonder why it is so pale and pasty-looking, never thinking it is possible for it to be fat, and yet to be starving. What are you to give it instead of cornflour? Oatmeal. I answer in one word, oatmeal porridge.

A second practical remark I wish to make is that a diet may be perfectly nutritious, entirely suitable to the body, and yet inexpensive. This I can illustrate to you best and most speedily by two examples. On the board I have placed a table of two breakfasts, which states the ingredients of each breakfast, the amount of nourishment each supplies, given as grains of carbon and nitrogen, and the cost of each.

BREAKFAST A.

6 Ounces Oatmeal made into Porridge,	*Yields*
10 Ounces Sweet Milk,	120 grains Nitrogen.
1 Pint Cocoa,	2145 „ Carbon.
¼ lb. Bread,	*Costs* 3d.
½ oz. Butter,	

BREAKFAST B.

1 Pint Coffee,	*Yields*
1 Egg,	80 grains Nitrogen.
¼ lb. Bacon,	1792 „ Carbon.
½ lb. Bread,	*Costs* 5¾d.
1 oz. Butter,	

Breakfast B. yields one-third less tissue-repairing material than Breakfast A. It contains twice as much bread and butter, but it costs nearly double the money. What is the meaning of this? The answer is again in a single word—oatmeal porridge. The oatmeal porridge of Breakfast A. gives it a pre-eminence in nutritious qualities which ham and eggs cannot hope to rival.

Now I would like to say a word or two as to the relation which I think the question of food has to the question of intemperance. I believe with a few people—I think not very many, but still with a few—that intemperance is not a cause but an effect. I believe the tendency to drink, among our working classes at least, is largely the result of insufficient food—that it results largely from the want of food capable of yielding the necessary material for renewal of energy and repairing the waste of tissue. Our people may have a diet—apparently an abundant diet—of bread and butter and bacon, but it does not yield the quantity of carbon which is necessary for work, or it may yield the carbon and not the nitrogen. Our workman has a diet, and his wife has a diet, and his children have a diet, apparently as to quantity sufficient, but as to the essential ingredients absolutely insufficient. When the workman leaves his house to return to his work, after a diet which perhaps he has enjoyed, he feels a strange languor for which he cannot account, a want of energy for work, and so the inevitable tendency is a resort to the whisky shop. He puts

down a glass of whisky to raise the steam. It does good, or apparently good, in that it quickens the combination going on in his body, and for a period he raises the necessary steam for his work. The period is, however, followed by an inevitable period of reaction. He is draining out the capital of his body, instead of having a daily income for repairing the waste, and the inevitable end must be the physical bankruptcy of his body. I say there is a vast relationship between intemperance and insufficient food. In this I take it is one reason of such lectures as this, that we shall do something to extend knowledge among the people as to the proper food both as to quantity and quality ; and I should like to add that if we supplement this information by instruction, easily accessible to the poorest of our people—instruction as to not only what is the right kind of food, but instruction as to how to prepare that kind of food so that it may be set before our working-men in forms palatable and tempting, as well as nutritious—and one does not need to go to expense to do that—then, I think, we shall have taken the greatest step we can take to combat the terrible evil of intemperance.*

Dr M'Gregor Robertson, in acknowledging a vote of thanks proposed by Dr Bramwell, said—Let me only remark that I do not say insufficient food is the only cause of excessive drinking, but I believe from experience of the working classes in, at least, Glasgow, that insufficent food is a very productive cause of intemperance amongst the working classes. The experience from which I speak is considerable, and I could not imagine an argument which could dislodge me from that point of view. Of course we have intemperance among other classes where there is no question of insufficient food, and we must find other causes ; but among the working classes, I say, insufficient food is a great cause of intemperance. I should have liked to enter into some of the questions which Dr Byrom Bramwell has referred to. Regarding diet and climate it is not necessary to say much in Scotland ; our climate needs one kind of food, that which our national poet describes as " The halesome parritch, chief o' Scotia's food."

* The lecture was delivered from a few notes only, and has been printed from a shorthand report. I have carefully revised it, but have not attempted to alter the general style it assumed in course of delivery.—J. M'G.-R.

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